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Volume 19 April 1950 Number 4

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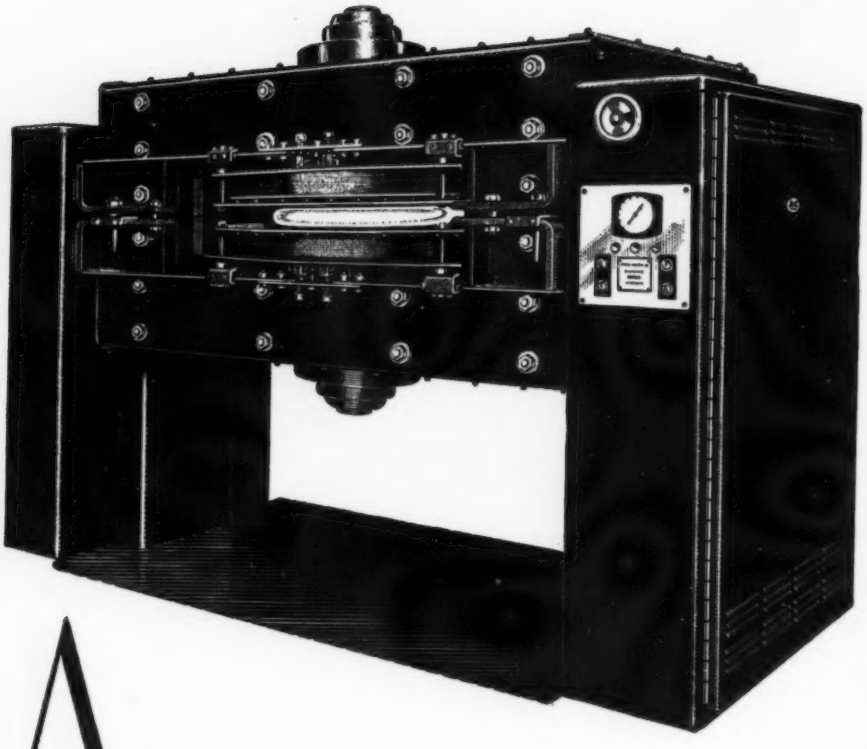

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This magazine is published to promote sound thought concerning industrial medicine and the surgery of trauma. To that end it will contain articles, news items, reports, digests, and other presentations, together with editors' comments. The editorial policy is to encourage frank discussion. On this basis contributions are invited. The editors will exercise care in checking on the accuracy of data printed but in all other respects articles and opinions of which expression is allowed are the opinions of their authors—the editors reserving in all cases the right to comment on the same in the current or any subsequent issues as they may be inclined.

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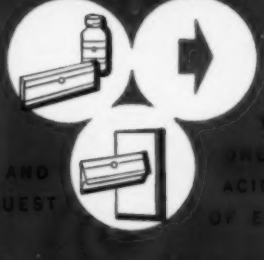

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NEWS

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JOHN M. KIMMICH, M.D., who had been with the Buick-Oldsmobile-Pontiac Assembly Plant of General Motors in Wilmington, Delaware, since 1945, is now Medical Director for Campbell Soup Company at Camden, New Jersey.

INDUSTRIAL Hygiene Foundation is joining with the School of Medicine and the Graduate School of Public Health, University of Pittsburgh, in helping the American Trudeau Society sponsor a post-graduate course on "Pulmonary Diseases and Their Relation to Employment" in Pittsburgh, May 15-19.

CHRISTOPHER LEGGO, M.D., Medical Director, California & Hawaiian Sugar Refining Corporation, Crockett, California, addressed the California Personnel Management Association at San Francisco on March 21. His subject was "Understanding Human Values in Employee Relations." DR. LEGGO is Secretary of the WESTERN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS, and Chairman of the Committee on Industrial Health of the California Medical Association.

JAMES G. TOWNSEND, M.D., chief of industrial hygiene, U. S. Public Health Service, and ROBERT A. KEHOE, M.D., of Kettering Laboratories, Cincinnati, are to be co-chairmen of the health hazards section of the first government sponsored conference on atmospheric pollution to be held in Washington, May 3-5, 1950. The conference is being organized under the auspices of the U. S. Bureau of Mines.

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ROBERT H. FLINN, M.D., is the newly appointed chief of Health Emergency Planning for the Public Health Service. He succeeds DR. NORVIN C. KIEFER, now on assignment to the National Security Resources Board as director of the Health Resources Division. Both men are medical officers in the Public Health Service Commissioned Corps. The Health Emergency Planning Unit was established in the Public Health Service in 1948. Its functions are to plan for more comprehensive public health catastrophe services in answer to peace-time emergency requests from states, and to cooperate with the National Security Resources Board and other governmental and voluntary agencies in civil defense planning. DR. FLINN has been at Public Health Service headquarters in Washington since 1948, directing the Medical Branch of the Federal Employee Health Division. He was assigned to the Chicago-Cook County Health Survey, and served as acting director for several months, before he went to Washington. During the war he was detailed to the Safety and Security Division in the Army's Ordnance Department as Medical Officer on industrial hygiene activities in explosive plants. Later he participated in the U. S. Strategic Bombing Survey of Japan. He was a member of the mission set up at the request of the War Department to study effects of strategic bombing upon health and medical facilities in Japan. He was born in Marion, Indiana; took his M.D. degree in 1930 at the Indiana University School of Medicine. He is a member of the American Medical Association, American College of Physicians, American Public Health Association, AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS, and other scientific organizations. He was recently certified as a member of the Founder's Group by the American Board of Preventive Medicine and Public Health.

THE Albany Society for the Advancement of Psychosomatic Medicine is planning a program for April 15 on "Psychosomatic Problems of Industrial Medicine and Compensation." The plan includes a panel discussion, with DR. B. L. VOSBURGH (General Electric) as Moderator, and DRS. DERSHIMER (du Pont) and COLLINS

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62nd Annual Meeting, April 4-6, 1950, at the Drake Hotel, Chicago

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American Association for the Advancement of Science, 1515 Massachusetts Ave., N.W., Washington 5, D.C.

American Association of Industrial Nurses, 654 Madison Ave., New York 21, N. Y. GLADYS L. DUNDORE, R.N., Executive Secretary.
April 23-29, 1950, Chicago.

American Association of Railway Surgeons, 5800 Stony Island Ave., Chicago 37, Illinois. CHESTER C. GUY, M.D., Secretary.

American Chemical Society, 1155 Sixteenth St., N.W., Washington 6, D.C. A. H. EMERY, Secretary.

(Eastman Kodak) among the panel participants.

New Component Society

FIFTY-THREE industrial physicians in the Philadelphia area met on February 18, 1950, to organize a Component Society of the AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS. The organizing committee included DR. CHARLES-FRANCIS LONG, Chairman; DR. HARVEY BARTLE, DR. LEOPOLD VACCARO, DR. GLENN S. EVERTS, DR. RALPH BRESLER, DR. F. B. LANAHAN, DR. HOWARD E. BRICKER, and DR. HEINRICH BRIEGER. The following committees were appointed: Constitution and By-Laws—DR. LEOPOLD VACCARO, Chairman; DRS. RALPH BRESLER, F. B. LANAHAN, HARVEY BARTLE, EDGAR K. LINDER, WILLIAM D. FRAZIER; Nominating Committee for Temporary Officers—DR. GLENN S. EVERTS, Chairman; DRS. HEINRICH BRIEGER, JOHN M. KIMMICH, LEMUEL McGEE.

CLARENCE W. HOPKINS, M.D., 77, who was Chief Surgeon of the Chicago & North Western Railway from 1914 until his retirement April 1, 1934, died Friday, March 17, 1950, at Elmhurst Memorial Hospital. DR. HOPKINS was born in Denton, Maryland, September 23, 1872. He was graduated from Northwestern University School of Medicine in 1901 and established his practice in Chicago. He was Fellow Emeritus of the American College of Surgeons, a member of the American Medical Association, and the Illinois State and Chicago Medical societies, and an Honorary Member of the AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS.

American College of Physicians, 4200 Pine St., Philadelphia 4, Pa. E. R. LOVELAND, Secretary.

American College of Surgeons, 40 East Erie St., Chicago 11, Ill.

American Conference of Governmental Industrial Hygienists, U. S. Public Health Service, Washington, D. C. J. J. BLOOMFIELD, Secy-Treas.
April 23-29, 1950, Chicago.

American Industrial Hygiene Association 4400 Fifth Ave., Pittsburgh 13, Pa HENRY F. SMYTH, JR., Executive Secy.
April 23-29, 1950, Chicago.

American Medical Association, Council on Industrial Health, 535 North Dearborn St., Chicago 10, Ill. CARL M. PETERSON, M.D., Secretary.

American Public Health Association, 1790 Broadway, New York 19, N. Y. REGINALD M. ATWATER, M.D., Executive Secretary.

Association for the Surgery of Trauma.

Canadian Public Health Association, Vancouver, B. C., Canada.

Council on Industrial Health, American Medical Association; Secretary: CARL M. PETERSON, M.D., 535 N. Dearborn St., Chicago 10.

Industrial Hygiene Foundation of America, 4400 Fifth Ave., Pittsburgh 13, Pa. JOHN F. McMAHON, Managing Director.

International Association of Industrial Accident Boards & Commissions, MARSHALL DAWSON, U.S. Dept. of Labor, Washington, D.C., Secretary-Treasurer.

Lead Industries Association, 420 Lexington Ave., New York 17, N.Y. ROBERT L. ZIEGFELD, Secretary-Treasurer.

National Council on Rehabilitation: Secretary-Treasurer: MR. HOLLAND HUDSON, 1790 Broadway, New York 19.

National Metal Congress, Philadelphia.

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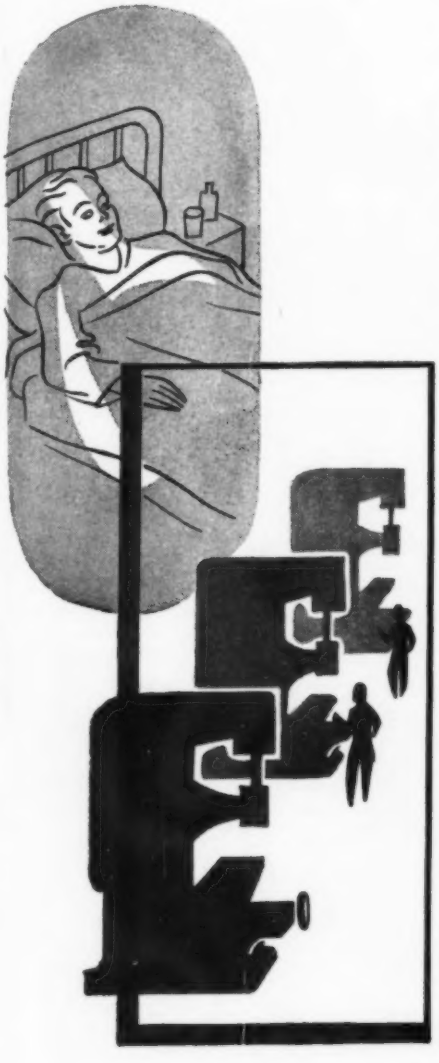

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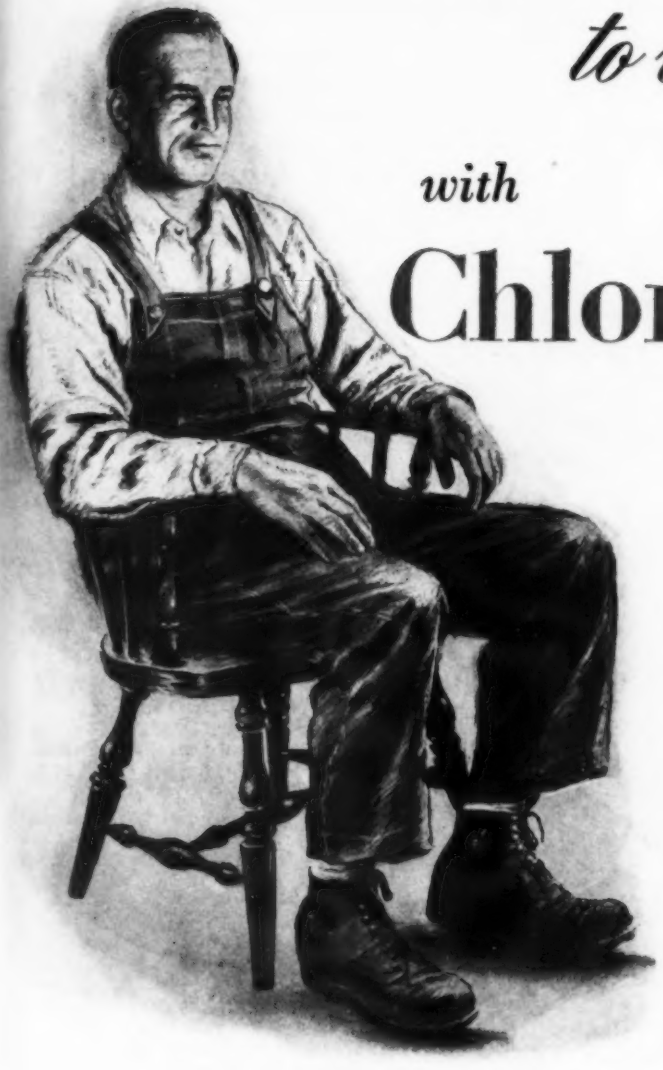

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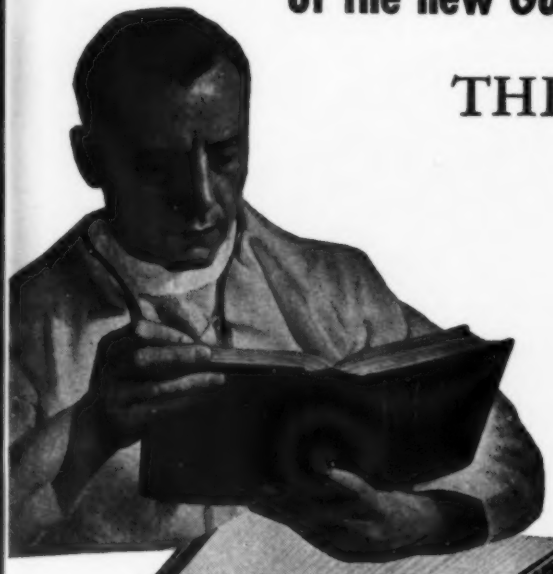

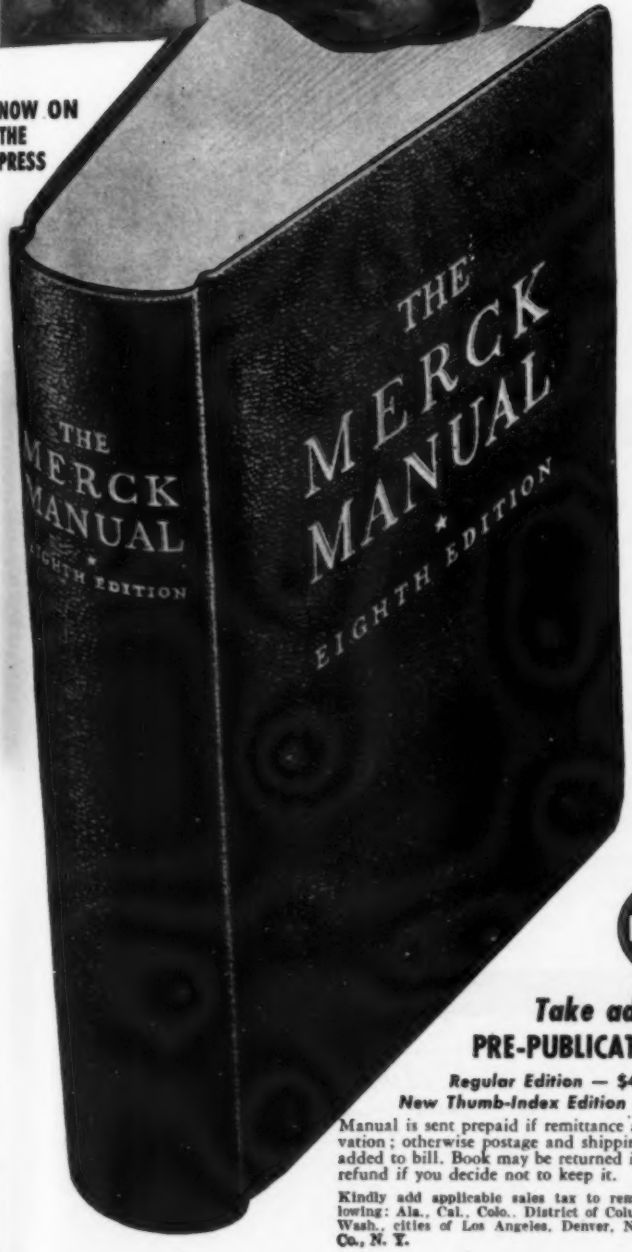

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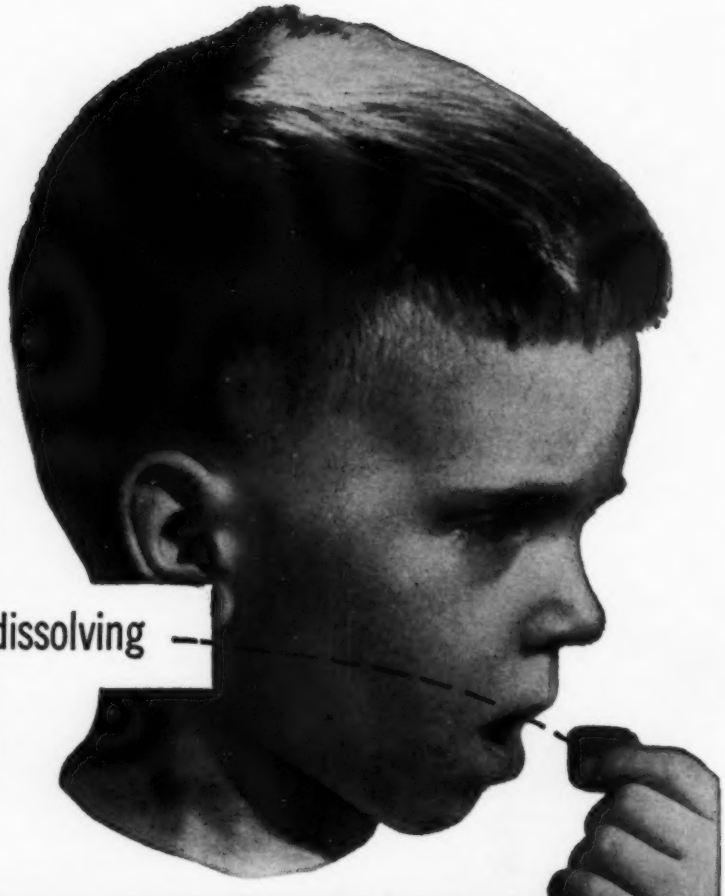

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1. Wilhelm, S. F. et al.: J.A.M.A. 141: 837 (1949).

2. Scudi, J. V., and Duca, C. J.: J. Urol. 61: 459 (1949).

3. Butt, A. J.: J. Florida M. A. 35: 430 (1949).

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NOTE THESE RESULTS

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INDUSTRIAL MEDICINE AND SURGERY

Volume 19 APRIL 1950 *Number 4*

SIDEROSIS

A Benign Pneumoconiosis Due to the Inhalation of Iron Dust

Part I: A Clinical, Roentgenological and Industrial Hygiene Study of Foundry Cleaning Room Employees

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IT IS A well recognized fact that an increasing number of materials used in manufacturing processes today can produce pulmonary damage and/or definite roentgenological changes in the lungs which may or may not result in varying degrees of disability. The social, economic and health aspects of such a problem demonstrate the necessity for proper evaluation of disease associated with gainful employment and emphasize the desirability of sound corrective measures in order to protect employees and assist management in providing a safe working environment.

Probably the most important respiratory condition associated with industrial procedures, at least from the standpoint of notoriety, is silicosis. In spite of the great amount of investigation and established criteria for the diagnosis of this disease, it is frequently misinterpreted by individuals who ought to be better informed on the subject. Workers are still advised that they have silicosis because of employment in an industry where dust may be present in the atmosphere, or because the roentgenograms of their chests contain shadows which look like those characteristic of the disease. Very little, if any, consideration is given to the matter of significant exposure, the composition of the dust, or the fact that there are numerous unrelated conditions which simulate silicosis roentgenographically. Among the latter, one of the most difficult to distinguish is siderosis which results from the deposition of inert, radio-opaque iron particles in the lungs.

Gardner[1] and others have demonstrated that silicosis is likely to develop only when significant concentrations of respirable-sized particles (those smaller than 10 microns and especially those smaller than 3 microns) of free or uncombined silica, have been inhaled over long periods of time (2 to 25 years with an average of 10 years). The specific action of free crystalline silica on pulmonary tissue produces nodular, fibrotic changes which give rise to clinical symptoms and typical roentgenological patterns especially in the late stages of the disease.

The experimental investigations performed by the Saranac Laboratory in connection with this study are reported in Part II of this article.

In silicosis the discrete, nodular opacities observed in the x-ray are very similar to those seen in chest films of people exposed to iron dust but they differ in that they usually increase in size after continued exposure to free silica. Later they tend to conglomerate, particularly in the presence of infection. Sander[2] points out that the hilar shadows in the silicotic roentgenogram are more prominent than those seen in radiographs of siderosis, while the scattered, rounded densities are less sharply defined. When tuberculous infection is superimposed on silicosis, the disease often progresses rapidly, in which case the change is readily discernible in the x-ray.

In a paper[3] presented at the Tenth Annual Meeting of the Industrial Hygiene Foundation of America on August 15, 1945, it was stated that for several years we had been concerned with pulmonary roentgenological findings especially among grinders and burners in our foundries because the shadows observed in the roentgenogram, and the clinical aspects and history of occupational exposure, were inconsistent with this concept of silicosis.

The first indication of incompatibility occurred during a periodic x-ray survey in 1941 in which diffuse nodular shadows appeared in serial films of the lungs of burners, following a term of exposure which appeared to be too short to produce such changes if due to silica. Similar patterns were observed among grinders and other employees in the cleaning room. Since it was an accepted fact up to that time that a silica hazard existed in all foundries, it was assumed that the shadows seen in the roentgenograms represented silicosis and they were so interpreted. At the moment we were not familiar with the work of Sander and Enzer[4] although we were aware that cases of atypical nodulation had been described in the literature. Our observations were sufficient to direct attention to the fact that we were probably dealing with a condition other than silicosis. Unlike the cases of siderosis described by these authors, the men in our group were known to have some degree of exposure to free silica as well as iron oxide.

Sander[5] and others state that siderosis is a benign pneumoconiosis which results from de-

posits of inert iron dust in the lungs without fibrosis or disability of any kind. This interpretation of the effect of inhaled iron particles on pulmonary tissue appears to be substantiated in the clinical cases and studies reported herewith. It is true also when the consequence of infection superimposed on a nodular background is considered. Clinically we have observed a number of individuals in this category whose roentgenographic patterns show no increase in nodular densities after shadows indicative of tuberculous infection have appeared in the x-ray.[6] Furthermore, impaired health and disability have not been significant factors in these employees. Similar results have been observed in the experimental animals used in this investigation. As will be pointed out, the introduction of tuberculous infection had no apparent influence on the nodulation.

Clinical and roentgenographic findings on persons exposed to iron dust have been described by McLaughlin, Grout, Barrie, and Harding,[7] of England. They report the case of a man who had been a silver polisher, using rouge (Fe_2O_3) as an abrasive, and in whom microscopic sections of the lungs showed aggregates of iron oxide particles in the pulmonary lymphatics without evidence of fibrosis. Pendergrass and Leopold,[8] in 1945, reported four cases of suggestive siderosis in metal workers in which there had been insufficient exposure to free silica to warrant a diagnosis of silicosis.

Doig and McLaughlin,[9] in 1948, reported densities in chest roentgenograms of electric arc welders which were interpreted as the result of deposition of iron oxide. In the opinion of these authors clearing of the shadows was noticeable in a few cases after a period of nine years. They reasoned that the radiographic nodulation of welders' siderosis is not necessarily permanent and that iron-oxide dust can be eliminated from the lung parenchyma when sufficient time has elapsed after cessation of exposure. Experience over the past 15 years does not warrant a similar conclusion in our cases, although we have felt that, once the nodular pattern is established, it seems to remain static.

Buckell, Garrad, Jupe, McLaughlin, and Perry[10] performed roentgenographic examinations of the chests of 171 iron turners and grinders (138 men and 33 women) exposed to dust in iron turneries in England. Changes in the lungs in the form of reticulation due to iron oxide were present in 15 persons. Five of these had been working at this occupation for more than 20 years. The changes were not gross and few symptoms were noted. Dust from rafter samples contained 37.1% metallic iron and 23.3% iron oxide. The total silica content was 5.4% and the silicate residue 1.3%.

Other observers have reported corresponding findings with regard to exposure to iron oxide but unfortunately a number of general practitioners, industrial physicians and roentgenologists, still insist on interpreting these radiographic patterns as first, second or third degree silicosis, regardless of the type of work or degree of exposure to respirable-sized particles of harmful dust to which employees have been subjected. Such injudicious interpretations frequently give rise to unwarranted diagnosis which results in unnecessary apprehension, financial loss and unjustified claims for disability.

Consideration of clinical and radiological findings, correlated with actual exposure as demonstrated by plant industrial hygiene surveys and analyses for significant concentrations of free silica and/or iron oxide, demonstrated the need for further study. The preponderance of iron and low amounts of silicon dioxide in the numerous dust samples collected, demanded a more accurate explanation than "free crystalline silica" in the production of the nodular shadows seen in the roentgenograms of our employees. An identical pattern was disclosed in chest x-rays of workers in six other company plants located in widely scattered sections of the United States and Canada. We were of the opinion that by observing the effect on laboratory animals, it would be possible to determine whether or not the dust generated in our cleaning and burning departments was capable of creating silicosis in the men working in these areas. The study would also result in a better understanding of the action of the particles on the lungs so that diffuse, discrete roentgenological densities could be interpreted more correctly. With the present variety of such prototypes, differentiation becomes more difficult and more important.

EARLY in 1945, the American Brake Shoe Company, through its Medical Department, inaugurated research of this nature under the direction of the late Dr. L. U. Gardner, at the Saranac Laboratory, Saranac Lake, New York. The work has been completed by Dr. A. J. Vorwald, whose studies in that regard are reported in Part II of this article. Industrial hygiene investigations are discussed in succeeding pages.

Those concerned with industrial health will readily admit that there is a definite need for more specific data upon which to base accurate medical guidance with regard to claims for respiratory disability than now exists. Misdiagnoses are not to the workers' advantage, and management and labor should realize that it is of mutual interest to arrive at a fair and accurate appraisal of the occupational disease in question. For instance, it is a great relief to an employee to be told that the shadows seen in the roentgenogram of his chest are not detrimental to health and have no more significance than, for example, a tattoo mark on the skin. It affords much peace of mind to be assured that his future status as a worker will not be affected by continued service at his present vocation. Ordinarily, if a man likes his job and the company for which he works, he does not want to sever connections, but at the same time his health comes first and if he cannot be convinced that his daily task offers no

undue risk, he will decide to leave, often to accept employment elsewhere at a reduced rate of pay. Thus an investigation of this sort would furnish more definite criteria for estimating pulmonary disability resulting from the inhalation of industrial dust. It would also facilitate settlement of suits involving compensation from this source.

Chest roentgenograms which showed abnormal findings in 69 grinders and burners were reviewed in the present study. Serial films were taken at intervals over a period of 16 years, from 1933 to 1949. From the year 1936 to the year 1941, no x-rays were made, since the present medical program was not in full operation. Previous to this time the great majority had annual roentgenograms over a period of three years. For the last six years however, each of these employees has had a chest x-ray at least once a year or more frequently as indicated. For the whole group, an average of eight serial films was made on each person during the 16-year period. The roentgenograms were interpreted by the same individuals, and a number were studied independently at the Trudeau Foundation, Saranac Lake, New York.

The group of 69 employees represents 18:5% of all workers employed in the cleaning rooms of six plants in the division and 26.8% of the burners and grinders in these departments. They were selected because their chest roentgenograms showed definite nodular shadows and since most of the men had long years of service at some form of grinding or burning. A few gave histories of previous employment in other industries. Some worked in coal mines, quarries or potteries for brief periods, and a considerable number had foundry experience in other organizations. With the exception of a few atypical cases, other burners and grinders have not been included in the study because to date they have not shown roentgenological evidence of nodulation. A number have exaggerated linear markings in their roentgenograms which are not sufficiently definite to warrant classification of occupational disease. The remaining employees were eliminated because they were not employed sufficiently long to have had significant exposure or else they could not be followed because of job transfers or terminations of service.

To obtain some idea of the time required for the development of nodular shadows in the roentgenogram, 46 employees who had worked in the cleaning room and machine shop for periods varying from three to 30 years were chosen for study from the group of 69 workers. They were picked because their occupations had been fairly constant. Length of exposure was considered as the time elapsing from the date of employment up to appearance of well-established nodular densities in the x-ray. As previously mentioned, there was a gap of five years (from the year 1936 to the year 1941) when no roentgenograms of the chest were made on these individuals. It is possible, therefore, that a number in the group might have developed their nodular densities before the year 1942 when the x-ray program was re-established. Also, if we included those cases whose earlier chest films suggested initial changes not sufficiently definite to warrant a diagnosis of nodulation, it is conceivable that a significant number of these workers would have acquired the condition sooner than indicated. The results of this study are shown in Table I.

TABLE I.
TIME REQUIRED FOR DEVELOPMENT OF NODULAR ROENTGENOGRAPHIC SHADOWS—46 EMPLOYEES

Years of Exposure	No. of Men with Definite Nodular Roentgenological Shadows	Percentage
1—5	5	10.8
6—10	26	56.5
11—15	7	15.2
16—20	3	6.5
21—25	1	2.2
26—30	4	8.8

It will be noted that 31 men, or 67% of the group, developed nodulation in less than 10 years. This is not usually the case in silicosis where considerably more time is required to produce nodular shadows in the roentgenogram. Silicosis *can* occur rapidly under severe exposure such as an atmospheric concentration of 100 million particles per cubic foot of air of a dust containing 50% free silica, but, as will be demonstrated in the industrial hygiene section of this paper, none of these employees was subjected to concentrations of this magnitude.

The average time of exposure required for the development of nodular shadows in the roentgenograms of the chests of the workers in this class is shown graphically in Fig. 1 (see page 163). It will be seen that the great majority of cases occurred during the eight-year interval.

In the earlier part of this discussion, it was mentioned that nodular densities appeared more rapidly in the roentgenograms of burners. In one instance this happened in approximately two and one-half years. Further analysis of the x-rays of the men, by departments, indicated that this observation is not only true, but is also consistent with exposure. The highest concentrations of iron oxide were found in the burning department, and there was a definite correlation between atmospheric contamination and appearance of nodulation in the roentgenograms of employees in the other divisions of the cleaning room. Table II demonstrates this situation.

The table also shows that the atmospheric

TABLE II.
RADIOLOGICAL NODULATION AND OCCUPATION—46 EMPLOYEES

Occupation	Av. No. Years Required to Develop Nodular Shadows in the Roentgenogram	No. of Employees	Percent	Av. Conc.* Iron-Mg. per Cubic Meter of Air
Burners	6.3	10	21.7	180
Grinders	10.7	27	58.6	61
Welders	14.5	2	4.5	59
Machine Shop Grinders	22.6	7	15.2	33

*Expressed as Fe_2O_3

concentrations of iron oxide are inversely proportional to the periods of time required to produce nodulation, or, in other words, as the exposure increases in severity, the time required for development of nodular shadows in the roentgenogram decreases. The foregoing findings are not in accord with generally accepted ideas as to the length of time required to produce silicosis. Gardner[11] stated the following with regard to the granite cutting and hematite mining industries: "If one compares the average exposures that were necessary to produce demonstrable silicosis before the introduction of modern protective methods, it will be found that they are much longer in these industries than in ones handling relatively pure silica. In the granite industry exposures of from 15 to 20 years are commonly necessary to provoke nodular fibrosis; in the hematite mines the average is in excess of 20 years." Johnstone[12] contends that disabling exposure consists of working in an atmosphere of free silica over a period of years, and that a significant degree of silicosis rarely develops until after 10 or more years of exposure. He points out that while exceptions have occurred in occupations such as sand-blasting or drilling in unventilated tunnels where the rock was high in silica content, they are unusual.

We have observed that once employees in the cleaning room have developed well-established nodular shadows in their roentgenograms, there appears to be no demonstrable change in subsequent x-rays even though the men have continued work at their regular occupations. This lack of change is not the case with persons having continued exposure to significant concentrations of respirable-sized particles of free silica. A review of findings in serial films of 69 employees in this department resulted as in Table III.

TABLE III.
ROENTGENOLOGICAL PROGRESSION OF NODULAR SHADOWS—69 GRINDERS AND BURNERS

No. of Men	Av. No. of Years Employed	Year Nodular Shadows Discovered	No. of Years under Roentgenographic Observation	Roent. Progression since appearance of well established Nodular Shadows
21	30.6	1933	16	0
1	25.0	1934	15	0
3	21.3	1936	13	0
32	19.6	1942	7	0
2	21.5	1944	5	0
10	10.7	1948	1	0

In order to correlate clinical and roentgenological findings with specific exposure to this industrial dust, a further study was undertaken. This involved gross samples of air-borne dust taken from three plants at widely separated locations. The various specimens were collected at the working places of one burner and eight grinders whose chest roentgenograms showed well-developed nodular shadows. As will be demonstrated later, the dust particles in the samples were separated by elutriation and those of respirable size (5 microns or less) were submitted to x-ray diffraction analysis to determine the amount of free silica present. The employees in question had worked on the same job for many years in unchanged environments. Because their exposure had been fairly constant, it was felt they would more accurately represent typical cases of the pulmonary occupational condition under discussion here. It also appeared desirable to determine to what extent they had been subjected to uncombined, respirable silica during their vocational lifetime. With one exception—a 63 year old employee, who had 36 years of service on the same job and was transferred to other work four years ago on account of dizziness and hypertension—all are working at their regular occupations at the present time.

Two cases developed shadows consistent with tuberculous infection in addition to their nodulation. The complication appeared in 1933 and 1936, respectively. Serial films show clearing, with resultant linear scar in one case and some increased density and demarcation in the other. The course of infection in these two cases has remained constant over a period of 12 years in spite of the nodular roentgenographic shadows and continuous exposure to dust.

The lack of clinical symptoms and absence of disability in these and other cases reported in the earlier part of this study are clearly inconsistent with the findings in individuals with silicosis, exposed over similar periods of time. They are in accord, however, with published studies involving other industries here and abroad where iron oxide constitutes a major exposure.

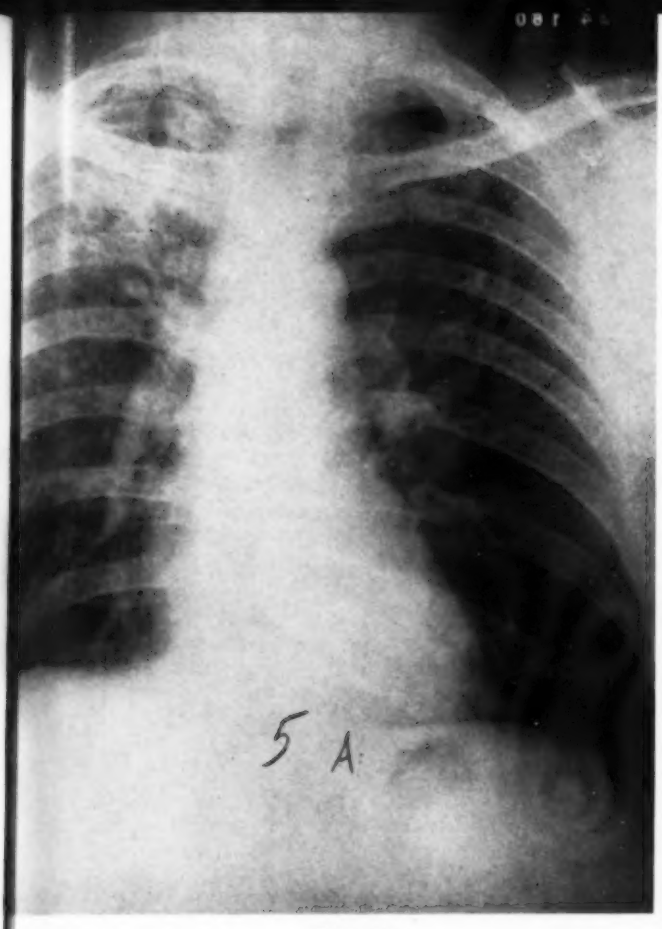
Case Reports

CASE 1 operates a grinding lathe in the machine section of the plant where large manganese steel castings ranging from 500 pounds (227 kg.) to several tons in weight are ground, sometimes to tolerances of 0.002 inch (0.0508 mm.). Vitrified abrasive wheels are used, and the point of contact is kept wet with water containing a soluble oil. The employee has worked on this particular job for 34 years without losing time except for a period of two weeks about 23 years ago, with what was diagnosed as pleurisy. Five years ago he had a hernia repaired and was away from work for two months. The operation was performed with the patient under local anesthesia, and no symptoms referable to his lungs occurred. Other than these two periods he has never lost a day's time because of illness. His appetite is good, with no discomfort after meals except occasional spells of mild indigestion.

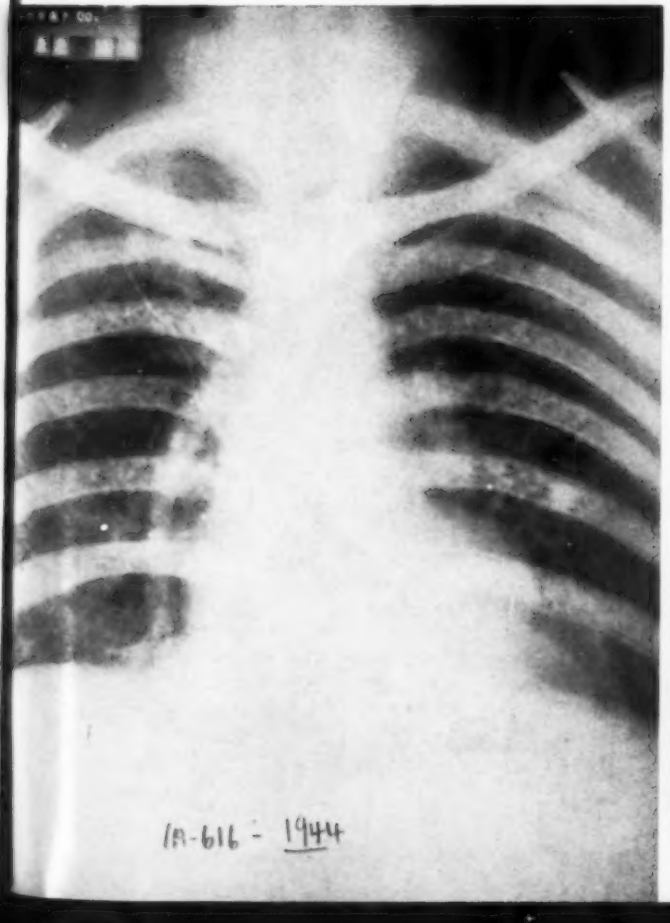
Examination revealed a well developed, well nourished white man, 57 years old. He presented a healthful, robust appearance. His height was 6 feet 1 inch (185.4 cm.) and he weighed 216 pounds (98 kg.). Blood pressure was 144 systolic and 82 diastolic. There was no evidence of disease of ear, nose or throat, and no enlargement of the thyroid gland. Examination of

the heart indicated no disease. An electrocardiogram was interpreted as being within normal limits. The pulse rate was 72 per minute, regular and of good volume. The chest was symmetric, breath sounds were normal throughout, and there was no other manifestation of disease. The remainder of the examination revealed no abnormality except for a rather large, easily reducible, recurrent inguinal hernia on the left side, apparently adequately controlled by a truss.

Roentgenograms of the chest were made for this worker in 1933, 1934, 1936, 1942, 1943, 1944, 1945, 1946, 1947, 1948 and 1949. The one made in 1933 showed evidence of extensive nodulation throughout both pulmonary fields with mottling, interpreted as tuberculous infection, involving the entire upper lobe of the right lung. The diagnosis was first degree silicosis with active infection. A roentgenogram in 1934 was interpreted in a similar fashion with the addition of suggestive cavitation. In 1936 the roentgenogram showed considerable clearing of the condition in the upper lobe of the right lung, the mottling being replaced by dense linear shadows. By 1944 no significant change was noted except that there seemed to be slightly more fibrosis of the infection with perhaps some accentuation of the nodulation. Subsequent roentgenograms, including stereoscopic views in 1946, demonstrated further clearing of the infection and replacement by linear scar. This change occurred while the man was continuously subjected to the same dust exposure. A Vollmer



Case 1-A
This roentgenogram was taken in 1934. It shows mottling interpreted as active tuberculosis infection involving the upper right lobe, superimposed on nodular background



Case 1-B
Roentgenogram made in 1944 showing healing and linear scar with no change in nodular shadows

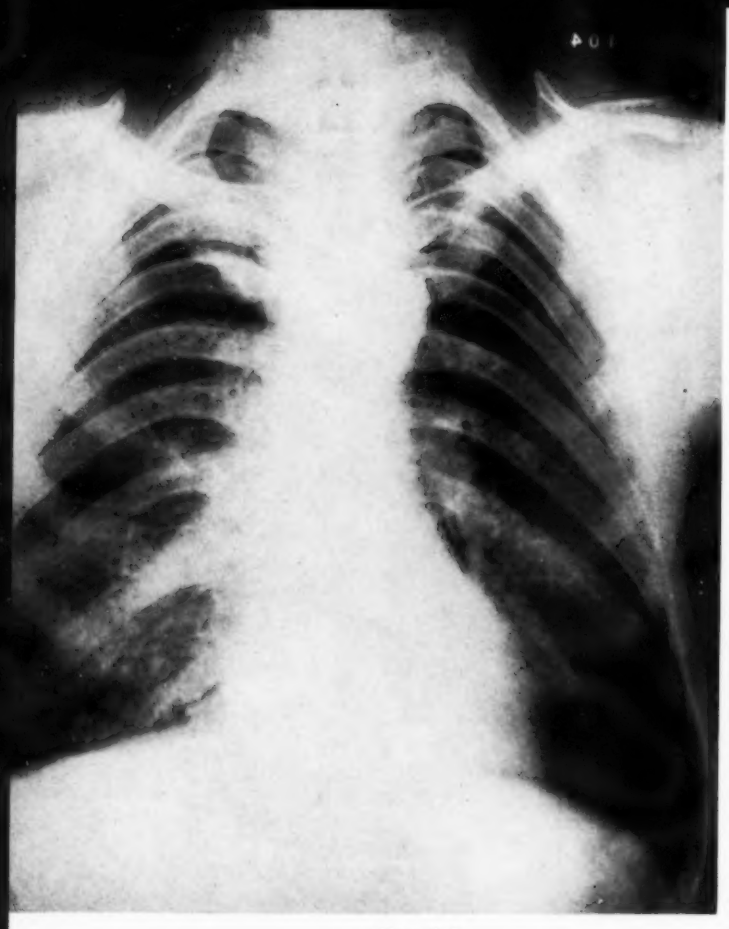
Case 1-C
Roentgenogram taken in 1947, three years later, showing no further change

patch test done recently resulted in a definite positive reaction. Three successive examinations of concentrated sputum were negative for acid-fast bacilli. The course of the infection in this case is contrary to the usual progression of tuberculosis, assuming that the nodulation observed in the roentgenogram is due to silicosis.

CASE 2 finishes rough manganese steel castings weighing from 500 to 10,000 pounds (4,535 kg.). The operation is done with a swing-frame grinder, and the employee has worked on this same job for the past 40 years. He has had no other occupation. He has no complaints and states that he feels well.

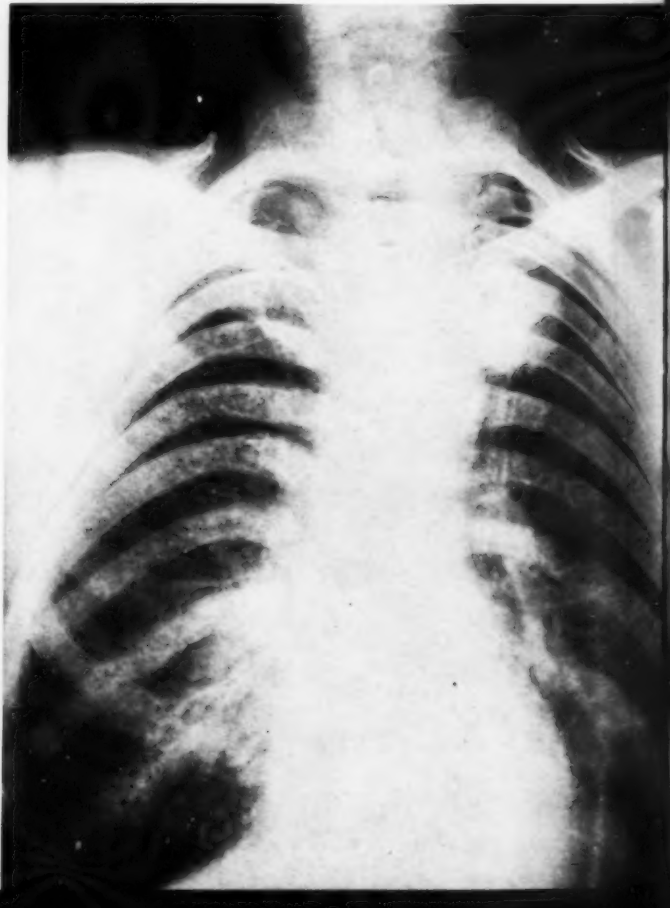
Physical examination revealed a well developed white man of 64 years, 5 feet 10 inches (177.8 cm.) tall, weighing 159 pounds (72 kg.). His temperature was 98.6. The pulse rate at rest was 76 per minute, after exercise 108 per minute, and two minutes later 76. The systolic blood pressure was 158 and the diastolic 80. Examination of the heart and lungs revealed no abnormality. The electrocardiogram revealed sinus rhythm with some interference of somatic origin based upon nervousness. There were occasional extra ventricular systoles. There was no evidence of coronary insufficiency or other cardiac pathology. No other significant defects were noted except an enlarged inguinal ring on the right side and superficial varicosities on the left leg.

Roentgenograms of the chest were made in 1933, 1934, 1936, 1942, 1943, 1944, 1945, 1946,



Case 2-A
Roentgenogram taken in 1934 showing diffuse, discrete nodular shadows typical of siderosis. These shadows were originally diagnosed as silicosis

Case 2-B
Roentgenogram taken in 1946 showing development of circumscribed density in left upper lobe with no change in nodular shadows throughout the lung fields



Case 2-C
Roentgenogram taken in 1949 showing no further change

1947, 1948 and 1949. The nodular shadows evident in the first three of these were diagnosed originally as uncomplicated silicosis. The 1936 roentgenogram suggests an area of beginning infection in the upper paravertebral area of the left lung. In the 1946 roentgenogram this is a definite, circumscribed density. Subsequent annual roentgenograms show no change except that possibly the shadow is slightly more defined. No change has occurred in the nodulation elsewhere in the lung.

A Vollmer patch test was done recently which elicited a positive reaction. Concentrated sputum on three successive days was negative for acid-fast bacilli.

In this series of roentgenograms, a shadow strongly suggestive of tuberculous infection has remained unchanged over a period of 12 years in spite of continuous exposure and the nodular shadows in the lungs.

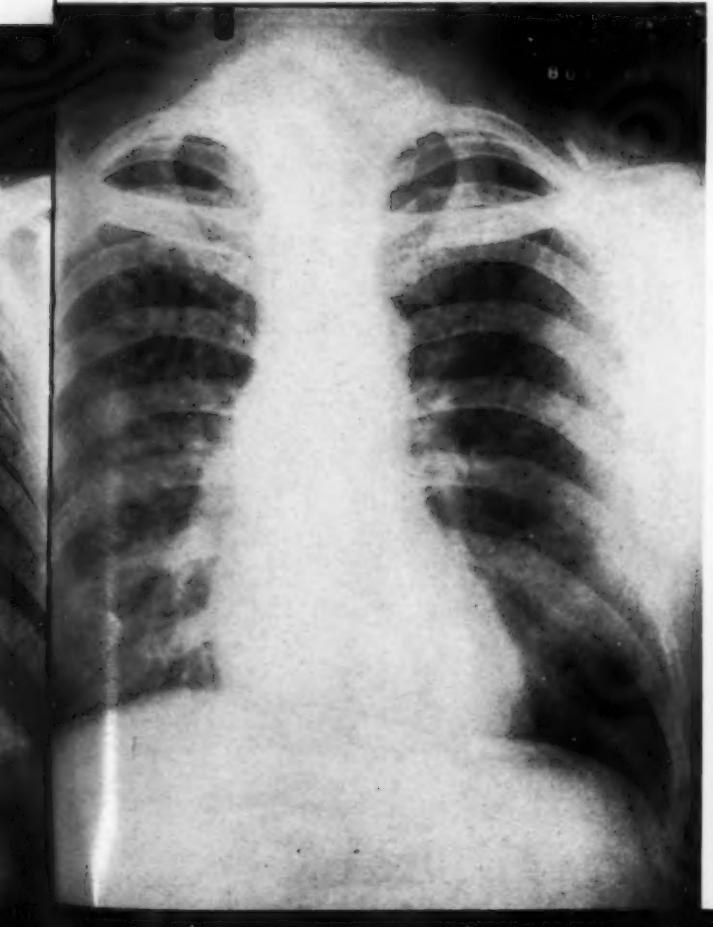
CASE 3 was employed as a stiff-shaft grinder for 36 years. Approximately four years ago he was transferred to work as a molder's helper because of hypertension and dizzy spells. He had worked at the job of grinding up to the time he assumed his other duties. In November, 1944, he complained of pain around his heart on exertion. He also had a mild hematemesis, swelling of the ankles and palpitation of the heart.

Physical examination revealed a systolic blood pressure of 210 and a diastolic pressure of 100, but examination of the lungs showed no specific abnormality. He continued working as a molder's helper up to April, 1948, but complained from time to time of dizzy spells. He was then given work as a janitor.

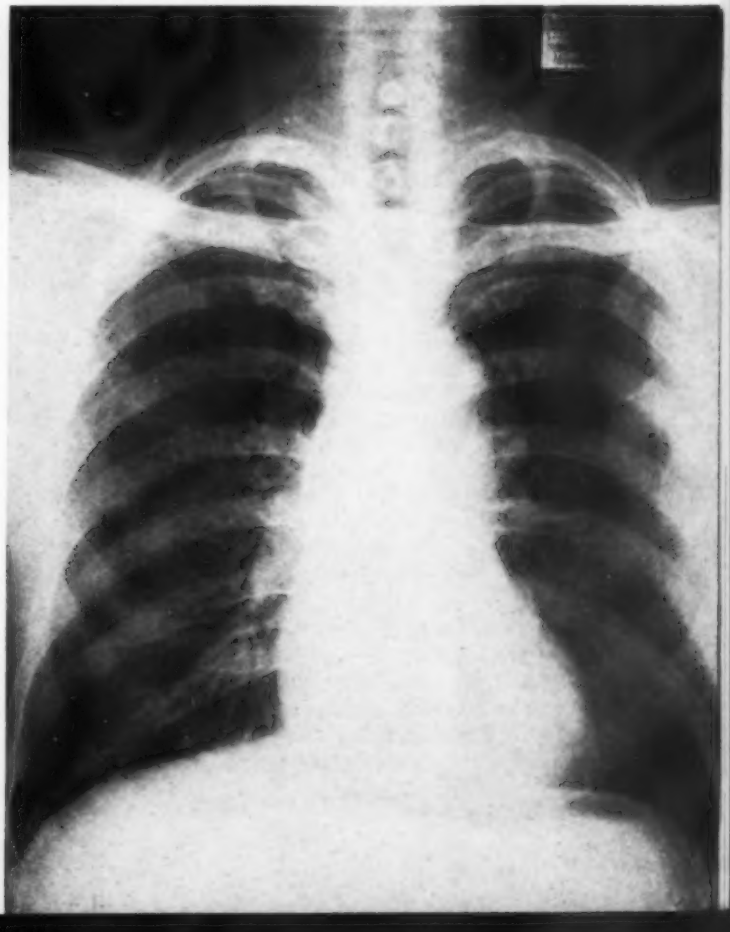
A recent physical examination showed a well developed but rather undernourished man of 63 years. His height was 5 feet 6 inches, and his weight 138 pounds (63 kg.). Blood pressure was 180 systolic and 130 diastolic. Vision was 20/100 in each eye. The teeth were in poor condition. The pulse was 84 per minute at rest, 112 after exercise and 84 two minutes later. Rhythm was irregular but the volume good. Examination of the lungs was negative. There was some cardiac enlargement and gross irregularity. An electrocardiogram indicated auricular fibrillation with a slow ventricular rate. The liver was slightly enlarged. Both external inguinal rings were relaxed.

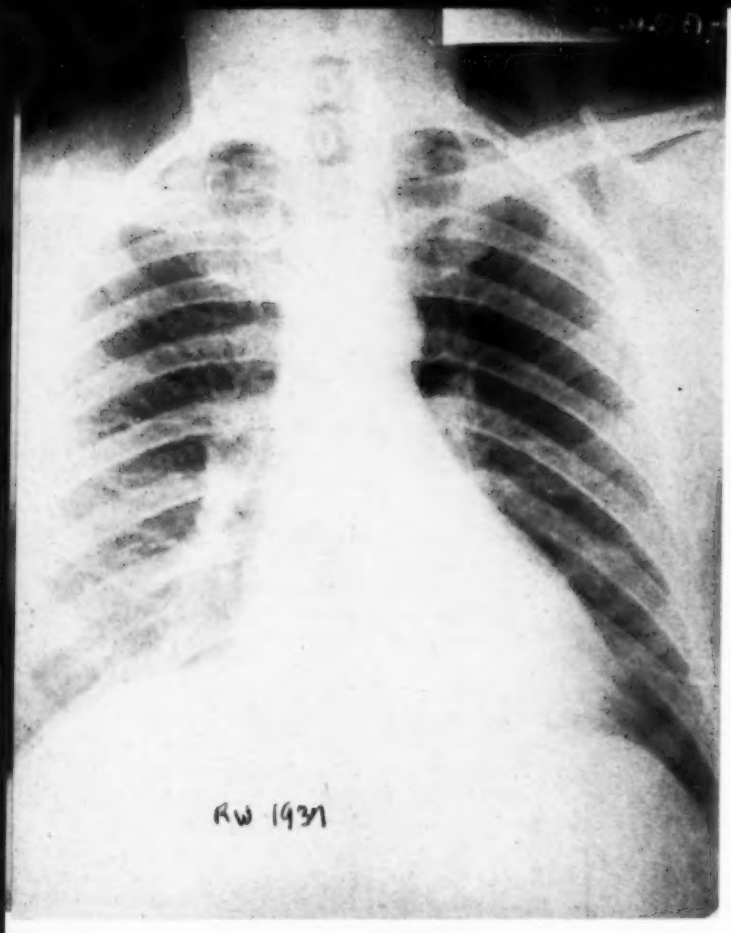
This employee had serial roentgenographic examinations of his chest in 1933, 1934, 1936, 1942, 1943, 1944, 1946, 1947, 1948 and 1949. Linear markings were sufficiently obliterated that an interpretation of first degree nodular silicosis was made in the 1933 film. No change was observed in succeeding roentgenograms until 1946, when the aortic shadow was seen to be widened with accompanying changes suggestive of hypertensive cardiovascular disease. No increase in the nodular pattern was noted. The radiological appearance during the next two

Case 3-A
Roentgenogram taken in 1934 showing diffuse nodular pattern of siderosis

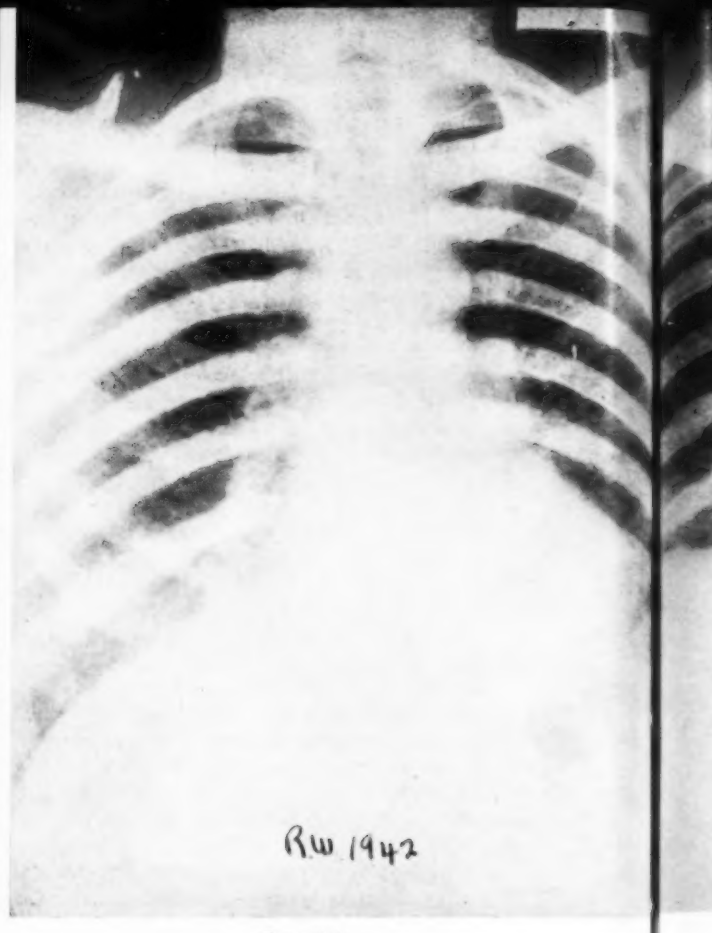


Case 3-B
Roentgenogram taken in 1947, 14 years later, showing evidence of cardiac pathology but no further change in the nodular pattern



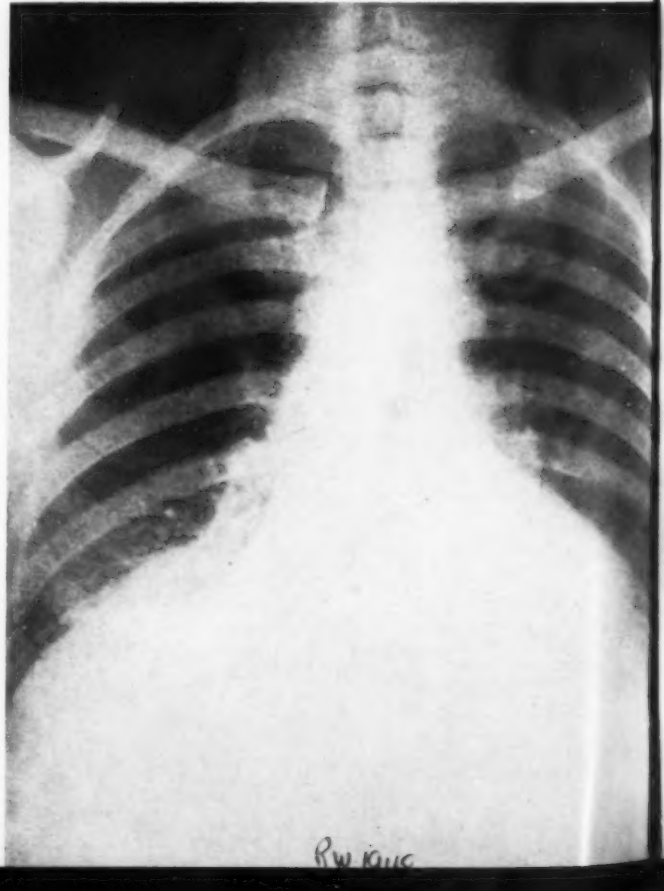


Case 4-A
Roentgenogram made in 1937 showing essentially normal chest except for some accentuation of linear markings compatible with age



Case 4-B
Roentgenogram made in 1942 showing well developed nodular shadows throughout both lung fields due to siderosis. Cardiac silhouette suggests changes associated with advancing years

Case 4-C
Roentgenogram made six years later showing more definite cardiovascular changes compatible with age but no further increase in the nodular densities



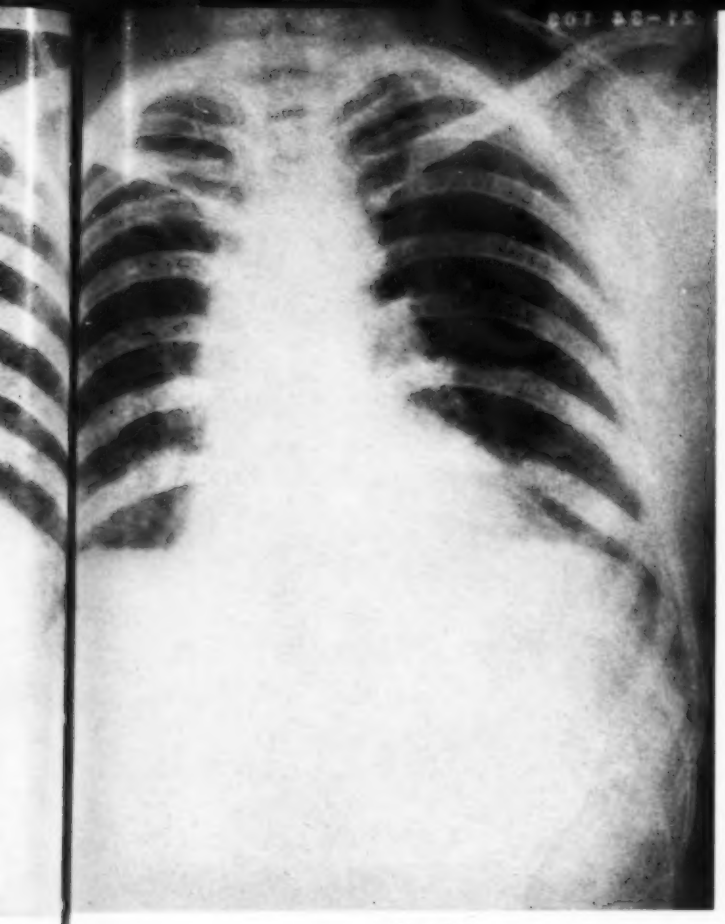
years remained constant except for some further increase in the vascular markings. In the 1949 roentgenogram there was a marked change in the cardiac outline with more widening of the aortic silhouette but no further change in the nodular shadows. At the present time the employee is under treatment for an auricular fibrillation with cardiac decompensation.

CASE 4 has worked in the cleaning room for 11 years. He was an acetylene burner for nine of those years. For the last two he has been a foreman in this same department and his exposure has been intermittent. He has remained in good health without complaints.

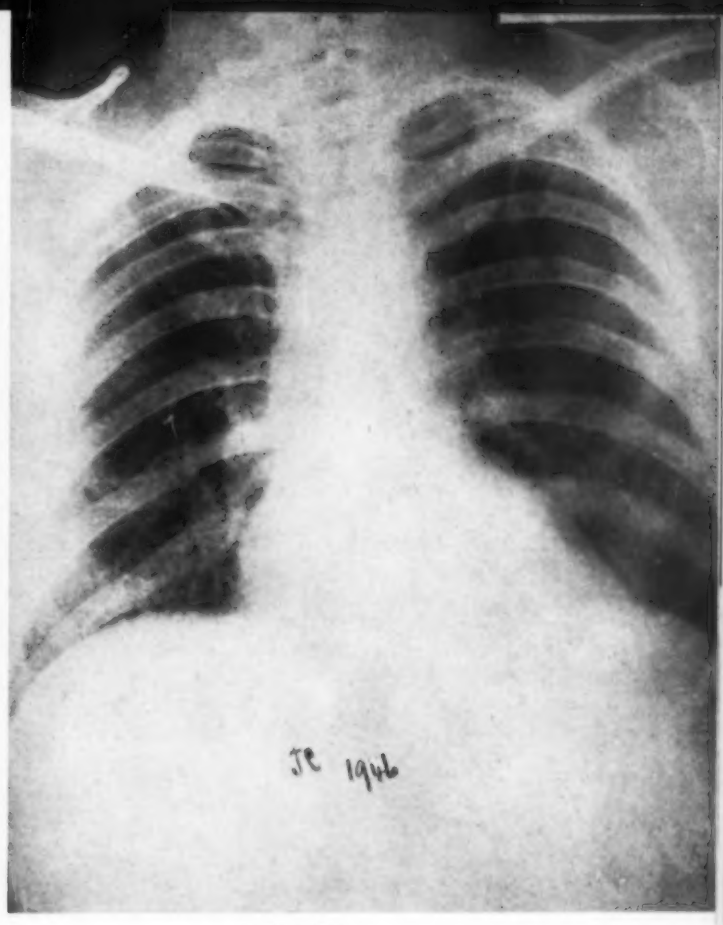
A recent physical examination disclosed a well developed man of 52 years who appeared somewhat overweight. His height was 5 feet 10 inches and weight 200 pounds (91 kg.). Blood pressure was 140 systolic and 90 diastolic. Pulse at rest was 78 per minute, after exercise 94, and 80 two minutes later. Examination of the heart and lungs was negative, and there were no other abnormal findings.

An electrocardiogram showed no evidence of myocardial damage.

Serial roentgenograms of the chest were made in 1937, 1942, 1944, 1945, 1946, 1947, 1948 and 1949. The 1937 film showed some accentuation of the linear markings. In 1942 there were definite nodular shadows. Subsequent films up to 1949 showed no further change.

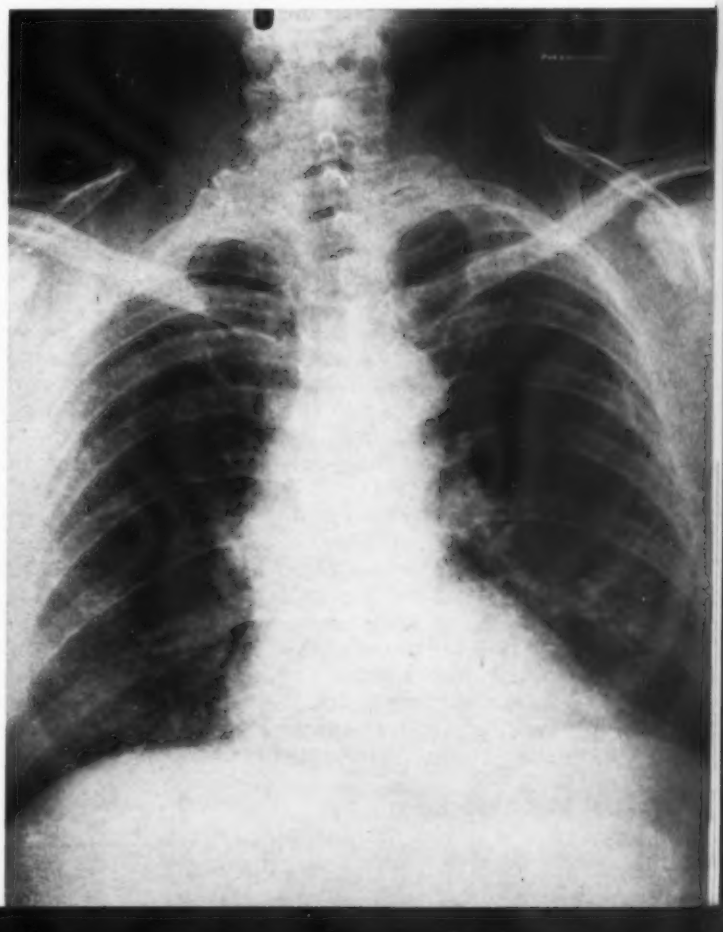


Case 5-A
Roentgenogram made in 1934 showing nodular shadows resulting from inhalation of iron oxide. The cardiac outline is somewhat distorted probably because of age and overweight



Case 5-B
Roentgenogram made in 1946 showing no significant change in the nodular pattern

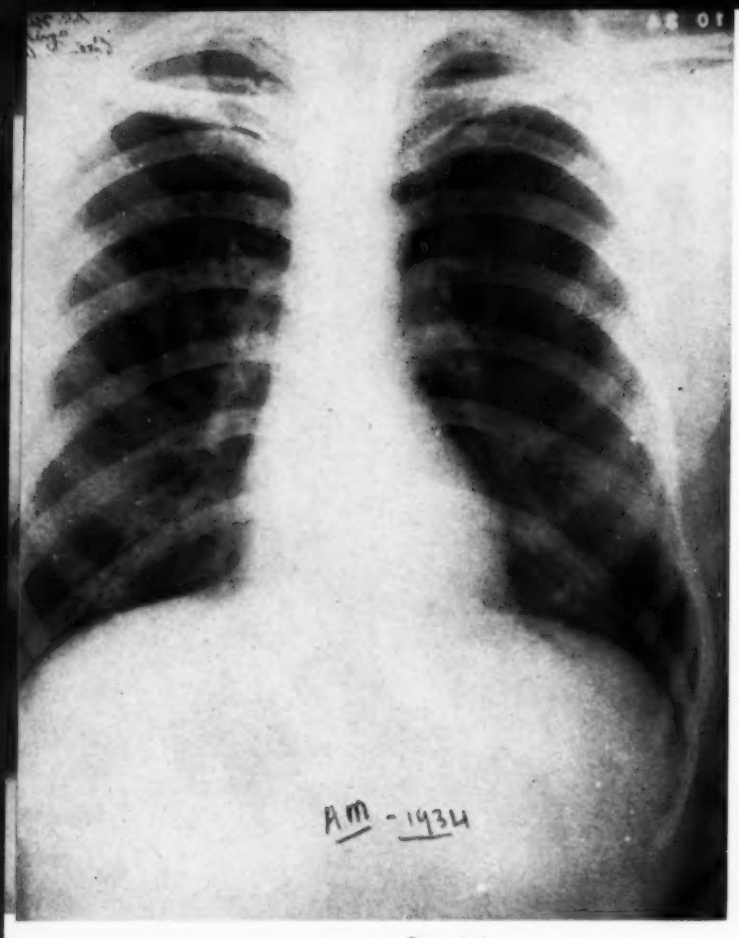
Case 5-C
Roentgenogram made in 1949 shows no further variation except that there is more evidence of cardiovascular change associated with age



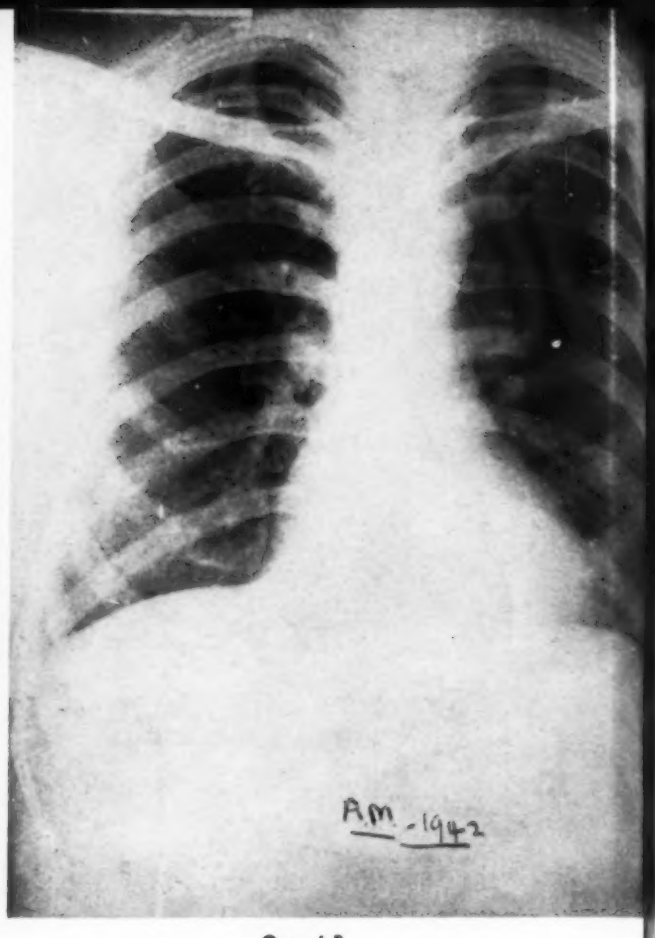
CASE 5 began work at his present location in 1914 and was a grinder until 1946, when he was transferred to a job as janitor at his own request. He operated a grinder for 32 years but also had some experience on a burner. During this time he had no specific complaints and no significant illnesses. He is now 57 years of age.

His latest physical examination revealed a well developed, well nourished man 5 feet 9 inches tall, weighing 188½ pounds (85 kg.). He appeared to be in good health. Tonsils were chronically inflamed, and there was evidence of impaired hearing in both ears. Temperature was 98.6. Blood pressure was 165 systolic and 78 diastolic. Pulse was 72 per minute at rest, 92 after exercise, and 72 two minutes later. Quality and rhythm were normal. Examination of the heart and lungs was negative. The electrocardiogram revealed no abnormal changes other than minor variations which were not excessive for age. No other significant clinical findings were noted.

This employee had x-ray examinations of his chest in 1933, 1934, 1936, 1942, 1946, 1947, 1948 and 1949. A definite nodular pattern was observed in the 1933 film which was more distinct in the 1946 roentgenogram. No further changes have been observed in subsequent films up to 1949, except that in later radiographs, linear markings are more exaggerated but compatible with the worker's age.

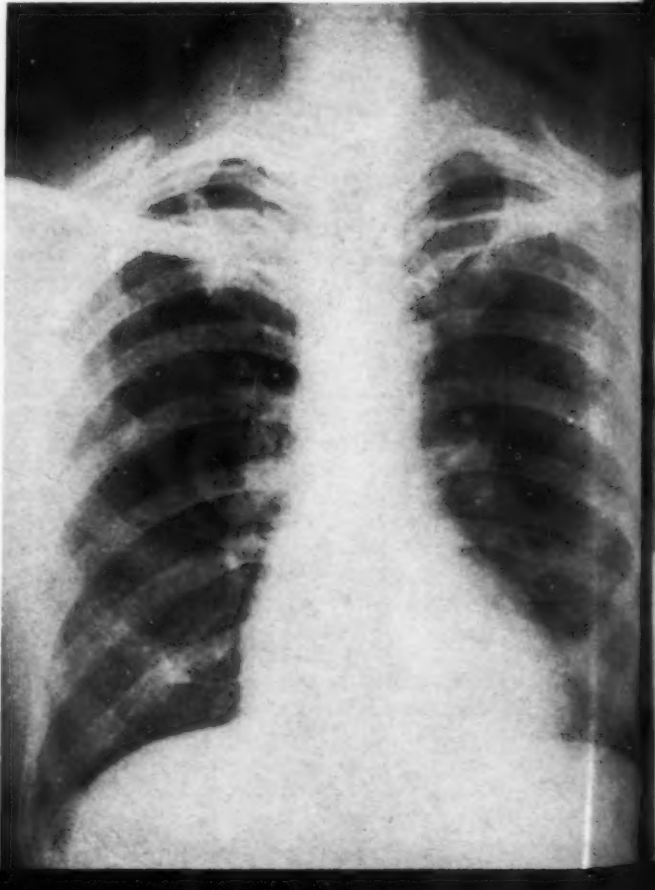


Case 6-A
Roentgenogram taken in 1934 showing no significant abnormality



Case 6-B
Roentgenogram taken in 1942 showing development of early siderosis

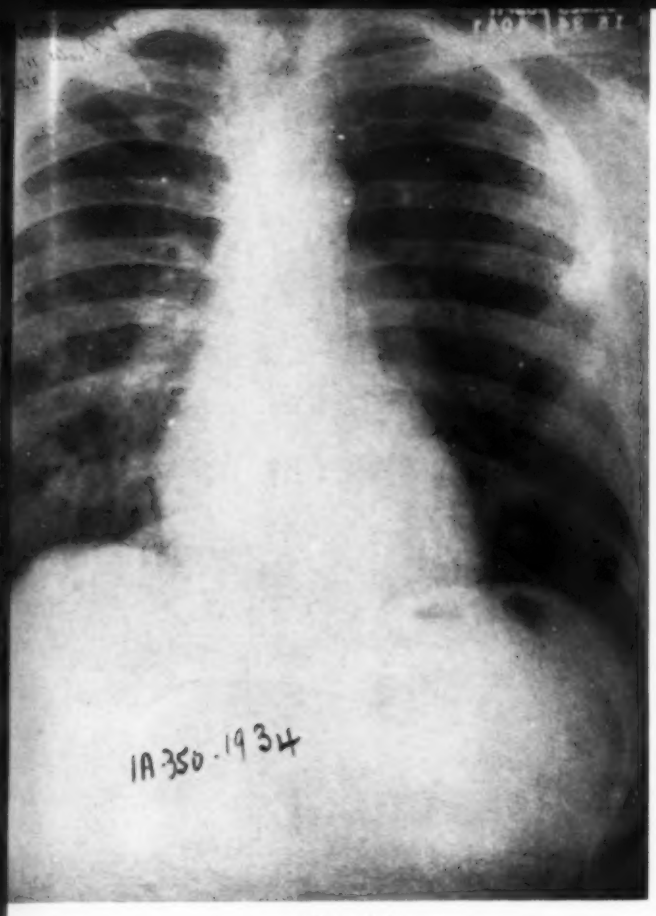
Case 6-C
Roentgenogram taken in 1947 showing development of shadow in upper right lobe suggestive of early minimal infection but no change in the nodulation. Subsequent films indicated no change in this shadow except some increased density



CASE 6 worked as a grinder for six years and a chipper four years. For the past three years he has been a crane operator in the cleaning room but has been doing odd jobs on the grinder during this time. He exposure to dust from grinding operations therefore has been fairly uniform. He has had no serious illnesses and no specific complaints up to the present.

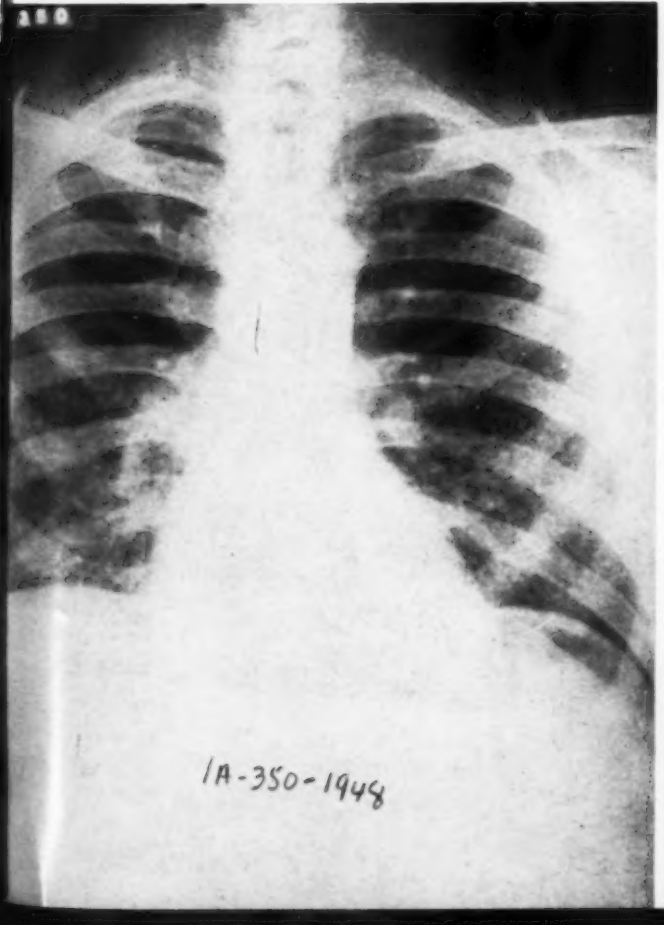
Physical examination revealed a well developed man, 47 years of age, 5 feet 6 inches tall, weighing 152 pounds (69 kg.). Temperature was 98.6. The pulse was 72 per minute at rest, 96 after exercise, and 70 two minutes later. Respirations were 14 per minute. The systolic blood pressure was 110, and diastolic 70. Examination of the chest was negative. A recent electrocardiogram revealed low amplitude of the QRS complex but this was not considered diagnostic of definite cardiac pathology. The remainder of the physical examination showed no significant abnormalities.

Chest roentgenograms were obtained on this employee in 1934, 1936, 1939, 1942, 1944, 1946, 1947 and 1949. A definite nodular pattern was first noted in 1942. This showed no further change up to the latest x-ray in 1949. In 1947 however, a small area of increased density suggesting early minimal infection in the upper right lobe was observed in the roentgenogram which was similar to that seen in the chest x-rays of other individuals with like exposure and reported in the paper[6] previously referred to in this study. Two subsequent roentgenograms



Case 7-A
Roentgenogram made in 1934 shows discrete, nodular pattern of siderosis, otherwise no evidence of pathology

Case 7-B
Roentgenogram made 14 years later showing no significant change except possibly more accentuation of the nodular shadows in a film of greater contrast



have indicated some increase in the density of this shadow but otherwise no significant change.

CASE 7 has been a stiff-shaft grinder for 25 years. He has worked continuously at the same occupation and has not lost time from work because of illness. He has had no specific complaints.

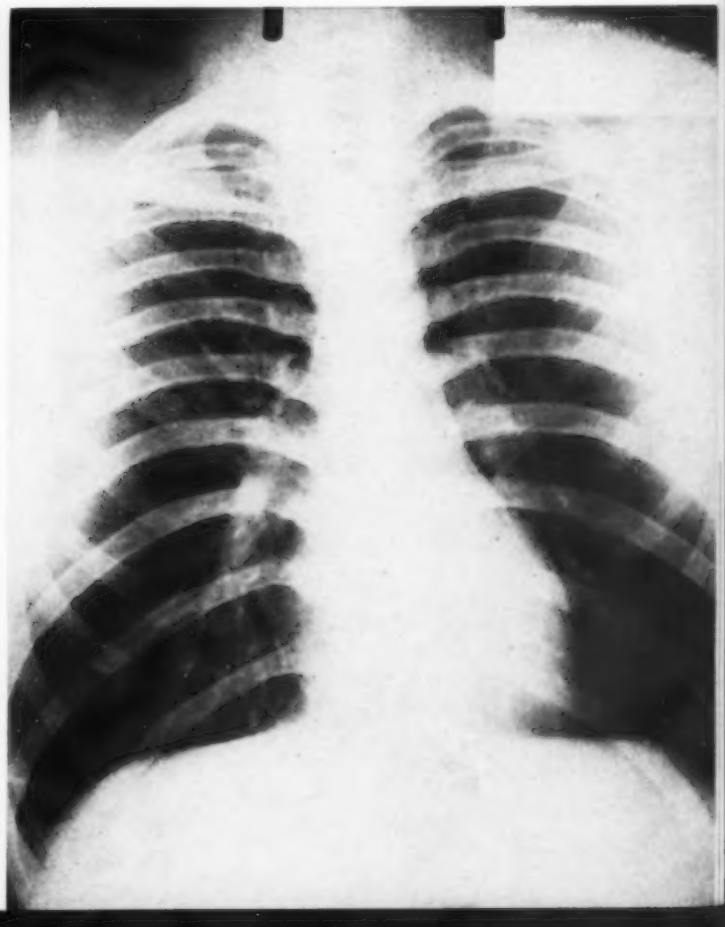
A recent physical examination revealed a well developed man of 55 years, apparently well nourished and healthy. He had pyorrhea, poor teeth, and was slightly overweight. He was 5 feet 6 inches tall and weighed 177 pounds (80 kg.). Blood pressure was 156 systolic and 84 diastolic. Temperature was 98.6. The pulse was 76 per minute at rest, 104 after exercise, and 76 two minutes later. The heart and lungs showed no evidence of disease. An electrocardiogram was within normal limits for the employee's age. The remainder of the examination was negative.

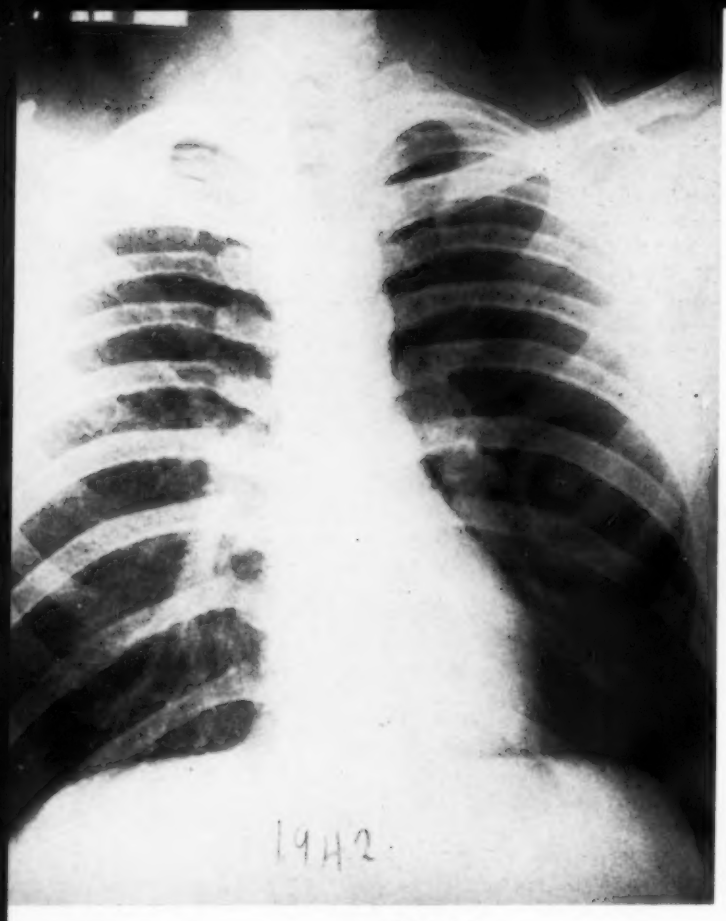
Roentgenograms of the chest were made in 1934, 1936, 1942, 1943, 1944, 1946, 1947, 1948 and 1949. Well developed nodular shadows were observed in the film of 1934 and there has been no change in these up to the present time.

CASE 8 worked as a stiff-shaft grinder in the cleaning room since coming to this location 14 years ago. He has not had any serious complaints or illnesses during this time.

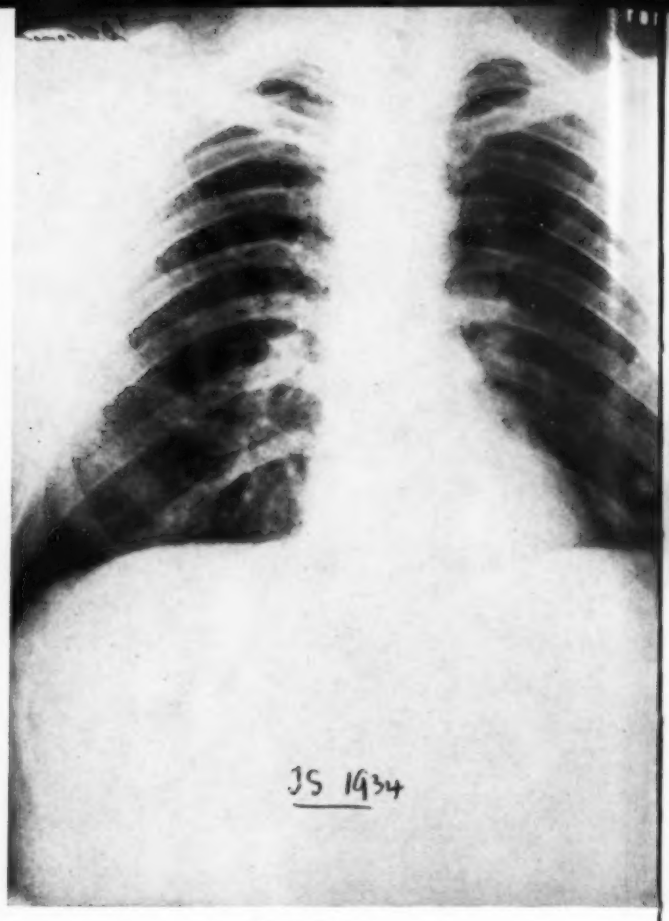
Physical examination revealed a young man of 34 years who appeared to be in good physical condition. Examination of the eyes, ears, nose

Case 8-A
Pre-employment roentgenogram made in 1935 showing normal chest



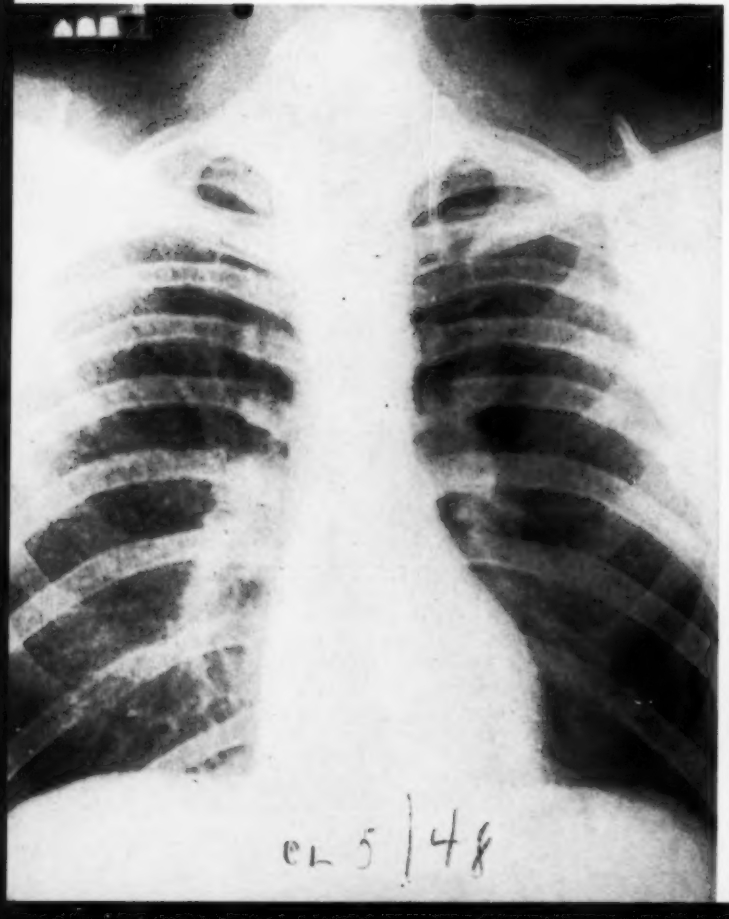


Case 8-B
Roentgenogram made about six years later in 1942, showing well developed nodular pattern of siderosis

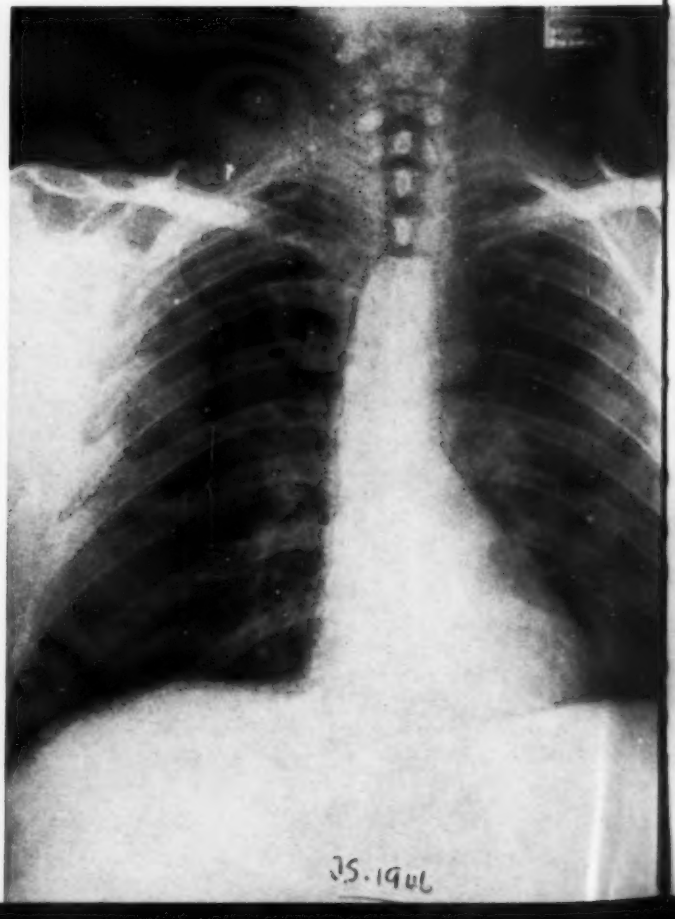


Case 9-A
Roentgenogram made in 1934 shows discrete nodular patterns of siderosis but is otherwise negative

Case 8-C
Roentgenogram made in 1948 showing no further change



Case 9-B
Roentgenogram taken 12 years later shows no change in the nodular shadows



and throat showed no abnormal findings. His temperature was 98.6. The pulse was 72 per minute at rest, 108 after exercise, and 72 two minutes later. He was 5 feet 11 inches tall and weighed 188 pounds (85 kg.). The systolic blood pressure was 126, diastolic 70. The heart and lungs showed no evidence of disease. An electrocardiogram showed mild right axis deviation and mild sinus tachycardia, otherwise no abnormal findings. The remainder of the examination was essentially negative.

This employee had his first chest x-ray examination in 1935. Other roentgenograms were made in 1936, 1942, 1943, 1944, 1946, 1947, 1948 and 1949. Nodular shadows were first noted in 1942, having developed in approximately six years' time. No further change has been observed in the nodulation up to 1949, despite the fact that he has been continuously exposed to iron-oxide dust.

CASE 9 has been employed as a machine grinder in the same location for 28 years. During this time he has had no serious illnesses and has worked steadily.

Physical examination disclosed a well developed man, 54 years of age, who appeared to be in good physical condition. Vision without glasses was 20/200, with glasses 20/20. Teeth were fair but there was some pyorrhea. Height was 5 feet 2½ inches, and weight 151 pounds (69 kg.). Systolic blood pressure was 140 and diastolic 78. The pulse at rest was 72 per minute, 98 after exercise, 72 two minutes later. The quality was good but there was some irregularity. Examination of the lungs revealed no abnormality. No definite heart damage was noted although there was irregular rhythm. The employee complained of some dyspnea in recent years. An electrocardiogram was interpreted as normal for the man's age. Physical examination was negative otherwise.

Roentgenograms of the chest were made in 1933, 1934, 1936, 1942, 1943, 1944, 1946, 1947, 1948 and 1949. Definite roentgenological nodular shadows were noted in 1933 and up to the present time there has been no evidence of progression of these in his serial films.

THE opportunity for study of postmortem material in this group of workers has not presented itself except in one instance. This occurred in an employee who worked as an acetylene burner for nine years in one of our plants. His chest roentgenogram showed nodular shadows of the type described here. In October, 1944, he was awarded compensation on the basis of a 50% disability from silicosis and siderosis. The man died in July, 1948, following a resection of the stomach for gastric carcinoma. The autopsy protocol failed to reveal any evidence of silicosis. An unsuccessful attempt was made to obtain sections of the lungs for microscopic study since these were not procured at the time of the postmortem examination. However, the fact that there was no gross evidence of silicosis —together with the similarity of the necropsy findings to those reported by other observers— furnishes additional confirmation that the shadows observed in the roentgenograms of this man's chest were not the result of exposure to free silica.

Industrial Hygiene Studies

TO CORRELATE the foregoing clinical and roentgenological findings with the atmospheric exposure to dust to which these employees were subjected, the industrial hygiene studies performed with respect to operations and plant environments are herewith reported in detail.

The majority of the employees whose roentgenograms of the chest show nodular shadows work in the cleaning room of the largest plant in the entire division. A few cases were discovered in this department in other localities. However, the type of operation is similar in each, so that a description of the procedure in the largest plant is representative of that in all the cleaning rooms involved.

This particular cleaning room is a building having an area of 35,000 square feet and a volume of approximately 1,000,000 cubic feet. It is divided into three low bays. There are about 280 square feet of floor space per man, but when the area allotted to storage, benches, and machines is deducted each worker probably has less than 140 square feet.

Castings vary in weight from a few pounds to several tons. Gates, risers, and fins are burned off with oxy-acetylene torches. This work is done in a fairly confined area on a sandy floor. Electric welding is also done on a number of

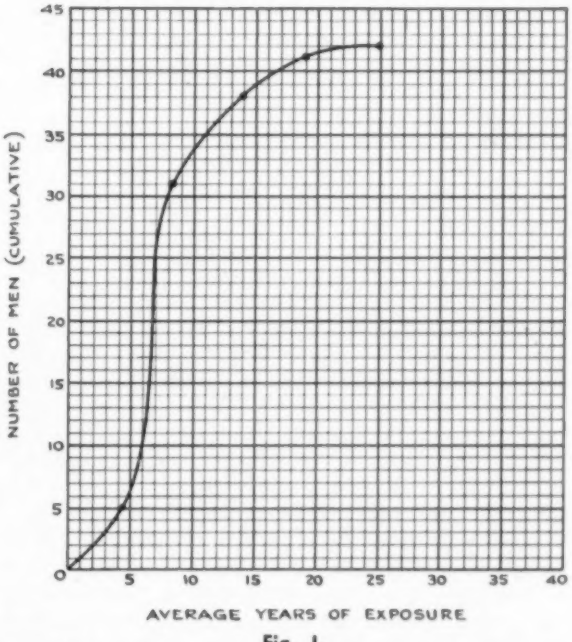


Fig. 1.
Cumulative curve showing average exposure time required for the development of nodular shadows in the roentgenograms of 46 employees

pre-cleaned castings so that the fume from this operation consists principally of iron oxide.

Small castings are first tumbled then finished on pedestal grinders which are exhausted. The larger pieces are cleaned by means of stiff-shaft, swing-frame, and small hand grinders. These grinding operations, as well as chipping procedures, produce varying amounts of dust according to the type of product being processed. The dust is composed of the abrasive material and plastic binder from the grinding wheel, adhering sand and scale, and metallic particles from the casting itself which may or may not be completely oxidized. Since the year 1928, 95% of the grinding wheels used in the plant have been composed of a resinoid bond and aluminum oxide abrasive. A few vitrified wheels are used for tool dressing. Scale consists of the oxides of the metals used in the manufacture of the products, and it appears as a flaky scab on the surface of the castings after they have been cooled. The oxides of iron and manganese are the principal constituents of the scale. The effect of dust from adjacent sources was recently demonstrated during tests performed at a single grinding unit when the rest of the cleaning room was shut down and only this machine was in use. Dust from this operation was observed to travel a distance of a hundred feet and remain suspended in the atmosphere for a period of several hours.

Measures for control of the dust were inadequate. Except for an ineffective exhaust hood on one swing-frame grinder, and suction hoods having a capacity of 4,500 cubic feet per minute on the pedestal grinders, there has been no other local exhaust equipment. Three fans with a total capacity of 30,000 cubic feet per minute are installed in the roof of the cleaning room. Because there is only one outside wall, natural ventilation even during warm weather has been insufficient.

Since the nodular shadows observed in the roentgenograms were originally attributed to dust from sand present on the surfaces of the casting, a hydroblast was installed in 1943 to clean these before grinding. The hydroblast removes adherent sand and scale from castings by means of a mixture of sand and water ejected under very high pressure, and at a nozzle velocity of over three miles per minute. This unit was installed at one end of the cleaning room. Castings go from the annealing furnaces, to the quench tanks, and then to the hydroblast before they are finished by the burners, welders, and grinders. Although this reduced the silica content of the dust from cleaning operations, the concentration of gross dust was practically the same as before.

With regard to the dust concentrations found in the cleaning room, only light field counts of midget impinger and electrostatic precipitator samples collected from the atmosphere during working hours at representative places are considered in this study. Particles above 10 microns in size were not counted.

From August to December, 1942, 41 such samples were collected. Total dust counts ranged from 4.0 to 67.2 million particles per cubic foot of air. Thirty-nine samples were collected in October, 1943, and 53 during September and December, 1944.

Tables IV and V show the distribution of these dust counts.

TABLE IV.
DISTRIBUTION OF DUST COUNTS

	RANGE—Million Particles Per Cubic Foot of Air						
	< 10	10-20	20-30	30-40	40-50	> 50	Total
No. samples 1942	4	13	5	12	3	4	41
No. samples 1943	11	17	9	2	0	0	39
No. samples 1944	7	25	11	6	2	2	53
Total							133

TABLE V.
PERCENTAGE DISTRIBUTION OF DUST COUNTS

	RANGE—Million Particles Per Cubic Foot of Air					
	< 10	10-20	20-30	30-40	40-50	> 50
Percent of Samples 1942	10	32	12	29	7	10
Percent of Samples 1943	28	44	23	5	—	—
Percent of Samples 1944	13	47	21	11	4	4

NOTE: Percentages are given to nearest round number.

The 1944 samples were collected after the hydroblast had been installed, and inspection of the tables shows that no significant difference in dust concentration was effected by the machine. Furthermore, it is seen that most of the counts are in the range of 10-20 million particles per cubic foot of air.

In view of the nodular roentgenological pattern found in some of the workers in this department, a severe exposure to silica was anticipated. However, for a mixed dust, such as existed in the cleaning room, the concentrations were not excessive, so that a diagnosis of silicosis seemed inconsistent with the actual findings.

In May, 1946, 43 air samples were collected. The concentration of total silica in these 43 samples was determined by making dust counts in an acid medium, on an aliquot of each so that the metallic components were in solution. Therefore the counts shown in Table VI represent not only the free silica particles present in the dust but also the other acid insoluble components such as corundum, silicates, plastic or resinoid grinding wheel binders, etc., which to date have not been shown to cause significant fibrotic changes in pulmonary tissue.

TABLE VI.
DISTRIBUTION OF TOTAL SILICA COUNTS

	RANGE—Million Particles Per Cubic Foot of Air				
	< 10	10-20	20-30	> 30	Total
No. Samples	20	20	3	None	43

It is significant that the total silica counts ranged from 0.2 to only 22.8 million particles per cubic foot of air with an average of 10.5 million. Thus the gross dust and total silica dust concentrations were not excessive; furthermore, as will be shown, the dust was composed mainly of iron oxide.

Fig. 2.

Fig. 3.

Fig. 2: Typical stiff-shaft grinding operation. Fig. 3: Method of collection of air-borne dust from swing-frame grinding operation. Note dust collector with flexible tubing in background. Air intakes were placed somewhat above the breathing level to eliminate large particles and obtain a representative sample of respirable-sized dust

In the discussion thus far, we have been dealing with actual dust counts of samples collected at working stations in the cleaning room. Since these have shown values which are not considered significant for mixed dust when judged by present accepted safe standards, it seemed desirable to investigate further the composition of the dust and the size of the particles involved. Dust standards are based on the free silica content so that the maximal allowable concentration is inversely proportional to the amount of free silica present. Obviously with a lower silica content, a higher degree of dustiness can be safely tolerated.

For these analytical investigations, pooled impinger as well as electrostatic precipitator samples of air-borne dust were collected and subjected to analysis by petrographic, x-ray diffraction, and chemical methods.

Petrographic analysis by the Saranac Laboratory of 12 pooled impinger samples collected from typical cleaning room operations in October, 1942, showed quartz 3%, and iron or other opaque material more than 66%. The particles ranged in size from less than 1 micron to over 70 microns. Most of the quartz particles were under 20 microns in diameter while many were as high as 35 microns.

One electrostatic precipitator sample of general atmosphere in the cleaning room, identified as No. 1, was subjected to x-ray diffraction analysis with the following result:

TABLE VII.
X-RAY DIFFRACTION ANALYSIS OF DUST
SAMPLE NO. 1*

Quartz	5.0%
Iron	44.0
Other insoluble material	28.0
Carborundum	18.0
Loss in weight on ignition	4.0
Unidentified	1.0

A second precipitator sample identified as No. 2,* collected at the same location on November 12, showed the following (Table VIII):

*Analytical work done by Saranac Laboratory.

TABLE VIII.
X-RAY DIFFRACTION ANALYSIS OF DUST
SAMPLE NO. 2*

Quartz	9.3%
Manganese	6.0
Others	Not Reported

Two additional dust samples obtained from the machine shop where only cleaned castings are ground, showed 0.8% and 0.7% quartz respectively by x-ray diffraction analysis. The other constituents of these samples were not determined.

After the hydroblast was installed, two gross electric precipitator samples, identified as No. 3 and No. 4, were collected for analysis and size fractionation. No. 3 represented the highest concentration of fine dust from grinding plus the fumes from burning and welding. No. 4 was collected seven feet above the floor at the center of a group of grinders in order to avoid collection of large particles and to obtain a more representative specimen of respirable air-borne dust.

The samples were studied by combined chemical, petrographic, and x-ray diffraction methods. Both were highly magnetic and consisted principally of magnetic iron oxide (FE_3O_4).

Table IX shows the analyses before fractionation:

TABLE IX.
ANALYSES BEFORE FRACTIONATION OF DUST*

		Sample No. 3	Sample No. 4
Total SiO_2		6.5%	8.9%
Free SiO_2	Quartz	3.1	3.9
	Cristobalite	0.1	0.3
	Tridymite	0.0	0.0
FE_3O_4		73.2	67.4
Mn		5.9	7.8
Corundum		1.5	4.1
Carbonates		Trace	Trace
Rutile		Trace	Trace
Loss on Ignition		6.2	3.2

It is significant that the total dust, including even the large particles not considered to be

*Analytical work done by Saranac Laboratory.

respirable, did not exceed 4.2% of free silica in each sample.

The metallic elements of the dust were removed by digesting with hydrochloric acid. The insoluble residue, which consisted of quartz, corundum, rutile, and iron-glass or other silicates, was then separated into size fractions.

The results are given as follows in Table X:

TABLE X.
PERCENTAGE OF ACID INSOLUBLE MATERIAL IN VARIOUS SIZE FRACTIONS OF DUST

		Sample No. 3	Sample No. 4
	Soluble in Acid	91.99%	85.15%
Insoluble in Acid	More than 10 Microns	4.03	8.67
	3-10 Microns	2.11	3.37
	1-3 Microns	0.87	1.34
	Less than 1 Micron	0.79	1.10
	Loss in Separating	0.30	0.37
	Total	100.00	100.00

Here again it is seen that most of the dust was soluble in acid and therefore considered metallic. Of the insoluble residue below 10 microns in size, less than half was respirable. This represents only a very small percentage of the total dust.

Each size fraction of insoluble residue was then subjected to chemical and petrographic analysis and values for the free silica and corundum content obtained.

These results are shown in Tables XI and XII:

TABLE XI.
ANALYSIS OF SIZE FRACTIONS OF DUST*
SAMPLE NO. 3

		< 1 MU	1-3 MU	3-10 MU	> 10 MU
Free Silica	Quartz	0.27%	0.32%	0.76%	1.79%
	Cristobalite	0.02	0.02	0.04	0.05
	Tridymite	0.00	0.00	0.00	0.00
Corundum		0.13	0.19	0.49	0.72
Silicates, rutile, etc.		0.28	0.34	0.82	1.47
Total		0.70	0.87	2.11	4.03

TABLE XII.
ANALYSIS OF SIZE FRACTIONS OF DUST*
SAMPLE NO. 4

		< 1 MU	1-3 MU	3-10 MU	> 10 MU
Free Silica	Quartz	0.27%	0.29%	0.68%	2.65%
	Cristobalite	0.03	0.03	0.07	0.18
	Tridymite	0.00	0.00	0.00	0.00
Corundum		0.12	0.28	0.68	3.04
Silicates, rutile etc.		0.68	0.74	1.94	2.80
Total		1.10	1.34	3.37	8.67

It is seen that most of the free silica existed as quartz rather than the more highly active forms, cristobalite and tridymite. Another noteworthy fact is that most of the free silica was found in the size fraction above 10 microns which is not considered respirable.

After the hydroblast had been installed and all the castings were being put through this machine before going to the cleaning room, no significant reduction in *total* dust was found, either in the general atmosphere or at specific job locations. Thirty-nine dust samples were collected in these same areas in October, 1943, before hydroblasting was initiated, and 39 in September, October, and November, 1944, after the hydroblast had been in use. The sampling stations and periods of time were comparable with respect to summer and winter conditions and collection.

The comparison is shown in Table XIII:

TABLE XIII.
COMPARISON OF DUST CONCENTRATIONS BEFORE AND AFTER HYDROBLASTING

	Range of Dust Count —Million Particles Per Cu. Ft. of Air	Av. Dust Count— Million Particles Per Cu. Ft. of Air
Before hydroblasting	4.6—39.7	16.0
After hydroblasting	3.9—37.2	15.4

Twenty of the dust samples collected in the year 1944 were analyzed for iron. The percentage of iron oxide expressed as FE_2O_3 ranged from 48.5% to 90.0% with an average of 68.1%.

In November, 1944, two samples of general atmosphere were collected in the same place as sample No. 2, namely, the cleaning room, and pooled. The dust counts on these were 22.4 and 26.0 million particles per cubic foot of air respectively. The total weight of dust collected was 229.8 milligrams with a sample volume of 273 cubic feet or 7.73 cubic meters of air. X-ray diffraction analysis of this sample, No. 5, showed the following results:

TABLE XIV.
X-RAY DIFFRACTION ANALYSIS OF DUST
SAMPLE NO. 5*

Insoluble 11.8%	Quartz	2.5%
	Cristobalite	0.2%
	Iron Glass	0.3%
	Opaque	Trace
Manganese as Mn		8.8%
FE_3O_4		67.8%
Loss on Ignition		4.7%

As pointed out previously, sample No. 2 was obtained before the installation of the hydroblast. Sample No. 5, Table XIV, was collected in the identical location after the hydroblast was installed. Analyses of these two samples show that the hydroblast reduced the quartz content of the atmospheric dust from 9.3% to 2.5%.

In 1946, the manganese content was determined on 49 samples of dust from the cleaning room. It ranged from 1.3% to 14.0% with an average of 5.4%. This work was done because some observers have suggested the possibility of manganese acting as a catalytic agent in potentiating the toxicity of silica dust. Our observations thus far do not produce any tangible evidence to substantiate this, neither are we aware that there has been any conclusive proof of this theory.

After it was suspected that iron was the etiological factor in the production of the shadows seen in the chest roentgenograms of the cleaning room personnel, it became necessary to correlate

*Analytical work done by Saranac Laboratory.

*Analytical work done by Saranac Laboratory.

TABLE XV.
ANALYSIS OF AIR-BORNE DUST COLLECTED AT REPRESENTATIVE STATIONS* OF NINE EMPLOYEES

Case No.	Plant No.	Study No.	Age	Occupation	Years of Exposure	Average Weight Percentage of Fraction of Dust Below 5 Microns in Size	Average Weight Percentage of Free Silica Below 5 Microns in Size	Average Weight Percentage of Iron as FE_2O_3 Below 5 Microns in Size
1	1	1A-616	57	Machine Grinder	34	18.1	5.6	64.3
2	1	1A-505	64	Swing-Frame Grinder	40	2.7	8.8	37.4
3	1	1A-181	63	Stiff-Shaft Grinder	36	27.6	2.3	61.0
4	2	2A-472	52	Burner	11	Not Determined	1.5	73.1
5	1	1A-173	57	Stiff-Shaft Grinder and Burner	32	17.4	6.8	51.5
6	5	5A-246	47	Chipper and Grinder	13	41.9	16.3	56.2
7	1	1A-350	55	Stiff-Shaft Grinder	25	12.1	4.9	62.7
8	1	1A-407	34	Stiff-Shaft Grinder	14	Not Determined	11.0	45.0
9	1	1A-756	54	Machine Grinder	28	Not Determined	5.2	66.3

the various factors of exposure. Therefore samples of atmospheric dust were analyzed and the results obtained calculated in terms of concentration of iron oxide per cubic meter of air.

Twenty-six samples of air-borne dust representative of the employees' daily exposure, were collected by means of the electrostatic precipitator, and each sample was analyzed chemically for iron. The results were expressed in milligrams of iron oxide (FE_2O_3) per cubic meter of air. Dust counts were also made on an aliquot of each sample. These ranged from 7.9 to 175 million particles per cubic foot of air, with an average of 32.2 million particles per cubic foot of air. The iron expressed as the oxide (FE_2O_3) ranged from 13.7 to 224.1 milligrams per cubic meter of air, with an average of 48.8 milligrams per cubic meter of air. The highest value both as to total dust count and amount of iron present was found at the burning operation.

In view of the moderate average dust counts coupled with the high average iron concentrations, it would appear that many of the iron particles are so small as to be beyond the resolving power of the optical system used in dust counting. It would seem, therefore, that in this situation a quantitative determination of iron should be used to supplement a standard dust count for appraising exposure.

The lowest and the highest published values for maximal allowable concentrations of iron oxide are 10 and 30 milligrams respectively per cubic meter of air. It is recognized that these levels are tentative and not based on conclusive evidence. The stiff-shaft grinders in plant No. 1 developed roentgenographic changes in their lungs after exposures ranging from 19 to 90 milligrams of iron per cubic meter of air—the average was 39 milligrams per cubic meter of air.

The analyses of the gross samples of air-borne dust having reference to the nine employees whose case histories are cited in this study, are reported herewith. Two large-volume (approximately 2,000 cubic feet) air samples were collected by means of a salicyclic acid filter and vacuum cleaner at each of the stations where these men worked. One sample was obtained during the winter when foundry windows and doors were closed. The other was taken in the summer months when maximal natural ventilation prevailed. The dust particles were separated into size fractions by a process of elutriation and the particles above 5 microns were discarded. The residues were then submitted to x-ray diffraction analysis to determine the percentage of free silica and iron oxide they contained. The results were averaged and are shown in Table XV above.

*Analytical work done by Saranac Laboratory.

It is seen by inspection of the table that by far the greatest percentage of dust at the specific stations selected is above 5 microns in size.

Two men, as indicated in the table, appear to have a high free silica exposure, namely, those showing 16.3% and 11.0%, respectively, of free silica. However, the total dust counts at the stations where these men work averaged 9.9 and 30.8 million particles per cubic foot of air, respectively, which would give calculated free silica counts of 1.6 and 3.4 million particles per cubic foot of air. These values are well below the accepted safe limits for siliceous dusts. Similar low values were found in all the areas where these men work.

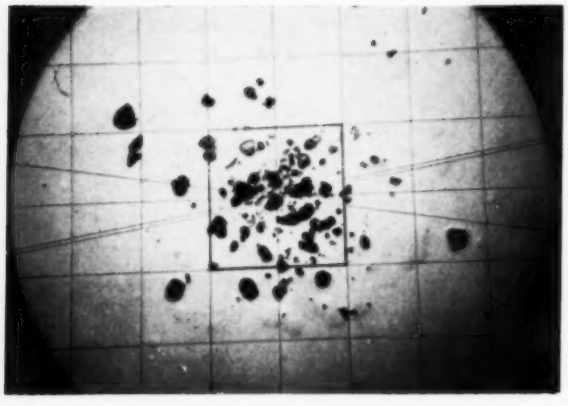
The following table (XVI) shows the ranges and averages of the dust concentrations actually found at the stations where the nine employees worked. It also demonstrates how high the dust concentration might have been and still be considered within safe limits in view of the free silica content of the samples:

TABLE XVI.
DUST CONCENTRATIONS FOUND AT NINE SELECTED STATIONS

Case No.	Plant No.	Study No.	Range of Dust Counts Found —Million Per Cubic Foot of air	Average Dust Counts Found —Million Per Cubic Foot of air	Av. Allowable Dust Counts—Million Particles per Cubic Foot of Air
1	1	1A-616	3.8—37.9	12.3	92
2	1	1A-505			
3	1	1A-181			
4	2	2A-472	1.4—210.0	64.7	330
5	1	1A-173			
6	5	5A-246	1.2—31.8	9.9	30
7	1	1A-350	0.8—153.6	30.8	79
8	1	1A-407			
9	1	1A-756			

*Based on percentage of free silica found at these nine stations.

The above values are based on midget impinger and electrostatic precipitator samples of total dust. Since the presently accepted safe limit is



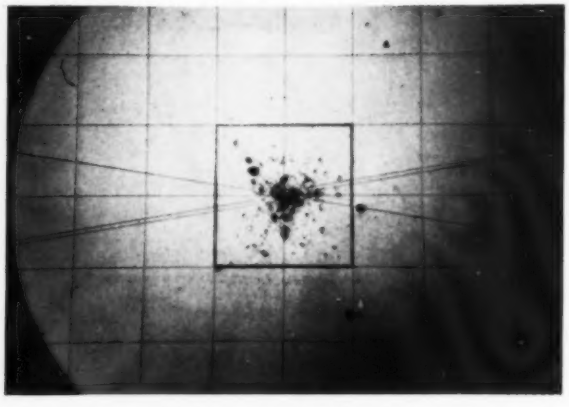


Fig. 4 (left): Dust from foundry shakeout illustrating generally large particle size associated with this operation. The distance between the diagonal parallel lines represents 5 microns. Fig. 5 (right): Dust from typical grinding operation showing extremely fine particle size

5 million particles per cubic foot of air for a dust composed solely of free silica (100%), a mixed dust such as we have here might be present in the atmosphere in a higher concentration according to the silica content without being harmful. It is standard practice, therefore, to divide the term 5 million by the known weight percentage of free silica in order to find a limiting value beyond which an environment may be termed hazardous as far as silica is concerned. The figures in the column called "allowable dust concentration" were found in this way.

Table XVII shows the iron concentrations at the nine selected stations. Most of these nine employees were exposed to average concentrations of iron oxide in excess of the highest published safe value and the ranges show that the exposure to iron was frequently severe.

The results of these investigations, carried out under both summer and winter conditions and using the accepted methods for determining significant exposure to harmful dust of respirable size, clearly indicate that the atmospheric amounts of free crystalline silica were well below accepted safe limits. On the other hand, the concentrations of air-borne particles of iron oxide were considerably in excess of the highest published allowable values, frequently reaching three to seven times these permissible limits at all stations.

TABLE XVII.
IRON CONCENTRATIONS AT NINE SELECTED STATIONS

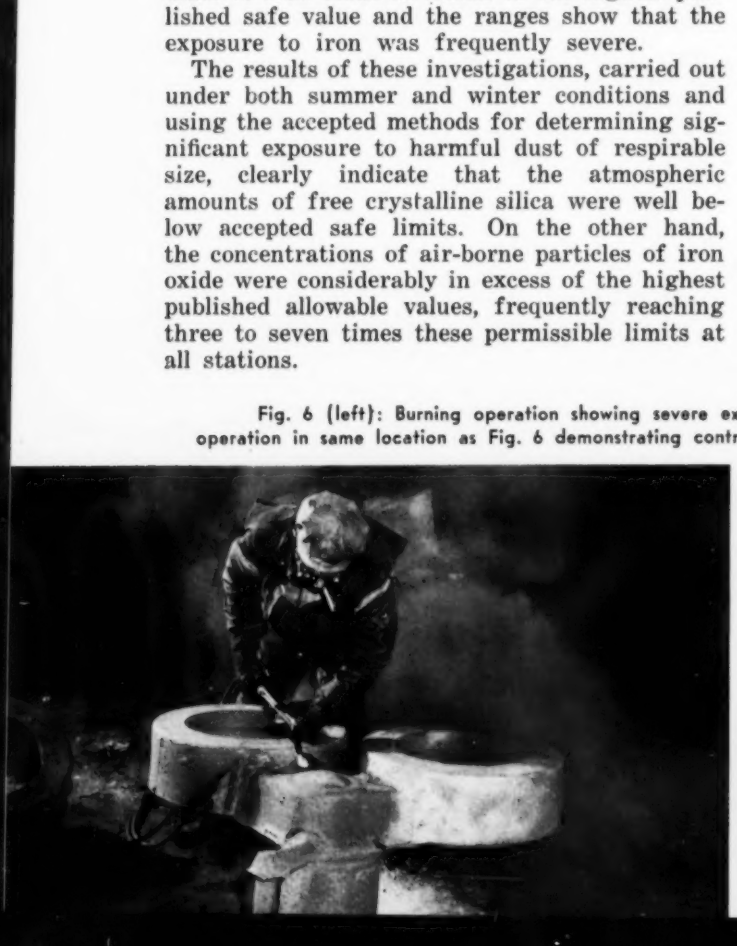
Case No.	Plant No.	Study No.	Concentrations of Iron Oxide—Milligrams Per Cubic Meter of Air: Range	Average
1	1	1A-616	14—84	29
2	1	1A-505		
3	1	1A-181		
4	2	2A-472	19—206	95
5	1	1A-173		
6	5	5A-246	0.5—189	35
7	1	1A-350	19—90	39
8	1	1A-407		
9	1	1A-756		

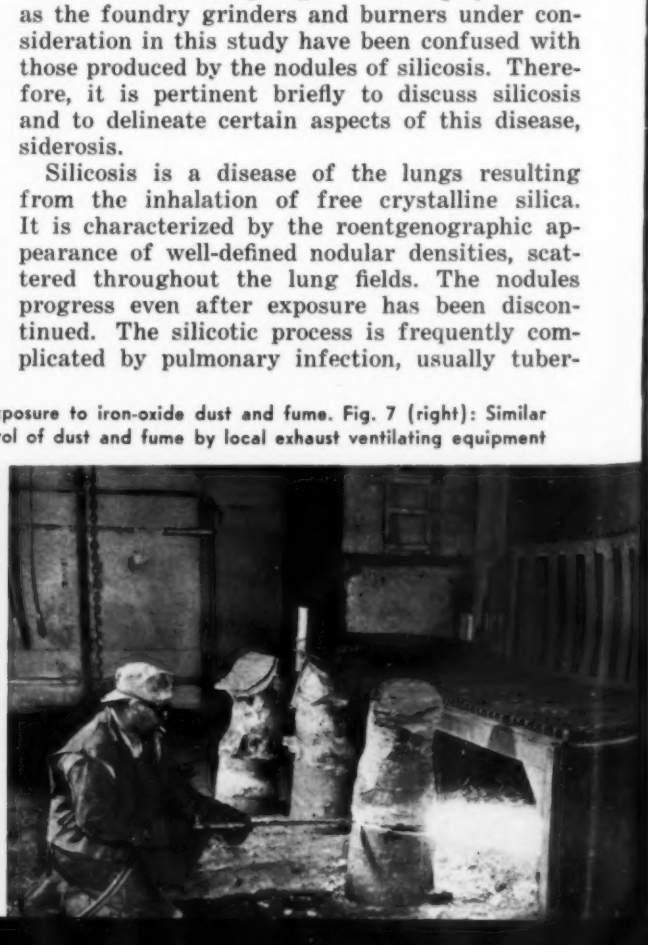
Comment

IT IS APPARENT that the nodular shadows present in the chest roentgenograms of employees such as the foundry grinders and burners under consideration in this study have been confused with those produced by the nodules of silicosis. Therefore, it is pertinent briefly to discuss silicosis and to delineate certain aspects of this disease, siderosis.

Silicosis is a disease of the lungs resulting from the inhalation of free crystalline silica. It is characterized by the roentgenographic appearance of well-defined nodular densities, scattered throughout the lung fields. The nodules progress even after exposure has been discontinued. The silicotic process is frequently complicated by pulmonary infection, usually tuber-

Fig. 6 (left): Burning operation showing severe exposure to iron-oxide dust and fume. Fig. 7 (right): Similar operation in same location as Fig. 6 demonstrating control of dust and fume by local exhaust ventilating equipment





culous. In consequence there develops frequently a conglomerate process in the lungs which interferes with respiratory function and which is accompanied by clinical signs and symptoms of pulmonary distress.

If the nodular shadows observed in the cases of the present study are the result of free silica, then it would seem logical to assume that progression of fibrosis and superimposed infection would be correspondingly rapid. However, the reverse is true in the employees we have observed to date. As pointed out previously, no progression was noted in 69 cases observed over a period of 16 years. Developments interpreted as superimposed tuberculous infection which remained static or showed a tendency to clear, were reported on four employees and since that time six additional cases have been noted which follow the same pattern. Clinically the men show no symptoms which might be attributed to occupational disease. Even though free silica may be inspired in small amounts, experience such as met with in the iron mining industry shows that large amounts of inhaled iron oxide may modify the toxic action of silica. More important is the fact that exhaustive hygienic and engineering studies of actual working environments failed to disclose exposure to atmospheric concentrations of free crystalline silica of respirable size sufficient to produce silicosis. These same investigations, however, demonstrated ample amounts of iron oxide in the air to cause siderosis. These facts, supported by the experimental evidence (see Part II) to the effect that this dust has not been shown capable of producing silicosis in susceptible animals, constitute the basis for the rejection of silica and the acceptance of iron oxide as the cause of the roentgenographic lung changes observed in these workers.

Summary

CLINICAL and pulmonary roentgenological findings observed in 69 foundry grinders and burners exposed to high concentrations of iron-oxide dust and insignificant amounts of free silica are presented.

The nodular shadows in the chest roentgenograms of these workers may easily be confused with those resulting from the inhalation of free crystalline silica. Differences in the radiological patterns are therefore enumerated and associated with occupational exposure. Case histories are given on nine selected employees whose roentgenograms show typical nodular shadows resulting from deposition of iron-oxide particles in the lungs.

Study of the 69 workers involved in this presentation, correlated with findings supplied by detailed hygienic plant surveys and experimental pathological investigation, demonstrates that the radiographic nodular shadows resulting from the inhalation of inert iron-oxide particles into the lungs represent siderosis and not silicosis as is frequently claimed.

In the present study, 328 representative samples of air-borne dust were collected by means of the midget impinger, electrostatic precipitator and salicylic acid filter, under summer and winter conditions of ventilation. *Total* dust counts ranged from 0.4 to 210 million particles per cubic foot of air, with an average of 25 million particles per cubic foot of air.

The samples were analyzed by chemical, petrographic, elutriation and x-ray diffraction methods. Additional analyses were made to determine the percentage of free silica and iron oxide in the particle size range below 5 microns. The results in all samples subjected to x-ray diffraction indicated that the amount of free silica in the atmospheric dust ranged from 1.5% to 16.3%, with an average of 6.2%. A dust sample containing 75% or even 100% free silica does not necessarily represent an unsafe atmosphere as long as the count is of a low order of magnitude. In this instance the average count was 25 million particles per cubic foot of air which is not considered excessive for a mixed dust. Also, the count included other components as well as free silica. In other words the average total dust count was moderate and the average percentage of free silica it contained was low. The iron oxide ranged from 37.4% to 90.0%, with an average of 64.3%. When the iron oxide was expressed in terms of atmospheric concentration, it ranged from 14 to 224 milligrams per cubic meter of air with an average of 49 milligrams per cubic meter of air.

The calculated values for exposure to free silica based on the dust counts together with the percentage of free silica are well below the maximal allowable concentration of 5 million particles per cubic foot of air. On the other hand, the average exposure to atmospheric iron oxide was well in excess of the highest published safe limit of 30 milligrams per cubic meter of air.

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SIDEROSIS

A Benign Pneumoconiosis Due to the Inhalation of Iron Dust

Part II: An Experimental Study of the Pulmonary Reaction Following Inhalation of Dust Generated by Foundry Cleaning Room Operations

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IT HAS been some eight or nine years since it was noted that individuals working in certain phases of the foundry industry, particularly grinder and burner operators, sometimes develop pulmonary changes which produce in chest roentgenograms shadows simulating those of silicosis. While many observers have assumed that silicosis was actually present in these individuals, other investigators including Sander,[1] Hamlin,[2] McLaughlin et al,[3] have presented data which strongly suggest that a positive diagnosis of silicosis should not be made in these cases since they exhibit distinct inconsistencies in the development and course of the pulmonary changes in comparison with cases of classical silicosis. The reasoning of these investigators is well summarized in Part I of this paper.

The chief points which militate against the diagnosis of silicosis are the early development of shadows, the lack of progression of the shadows and even retrogression after cessation of exposure,*[5] and the absence of evidence of a predisposition to tuberculosis among those exhibiting the characteristic roentgenographic shadows.

It has been shown both experimentally[6] and by industrial experience[7] that the inhalation of arc welding fumes can produce roentgenographic shadows difficult to distinguish from those of silicosis, but that the associated pulmonary lesions are not those of silicosis. The shadows in the roentgenograms of arc welders were attributable to the radio-opacity of iron oxide, the major constituent of the fumes. The studies cited above are not directly applicable to the problem in the cleaning rooms, however, because the particle size of the fumes was much smaller than that of the cleaning room dust and because none of the silica in the fumes was present as quartz, while about 4% of the cleaning room dust was quartz or cristobalite.

In view of the importance of this problem with respect to industrial hygiene procedures and to compensation claims, an experiment was undertaken in an attempt to produce roentgenographic shadows in animals by inhalation of the dust produced by operations in the foundry cleaning room, and to determine the nature of the lesions responsible for the shadows. The influence of this dust on associated tubercu'ous infection in guinea pigs was also investigated.

This experiment was carried on for a period of three years, since it has been noted in experiments with a variety of dusts that if the typical lesions of silicosis fail to appear in animals within this period, exposed industrial workers will not develop silicosis during an entire working lifetime. Not infrequently, experimental animals will develop typical silicotic lesions only during the last six months of a three-year experiment. For this reason, a dust should not be declared inert on the basis of an inhalation experiment of less than three years' duration.

The cost of these studies was underwritten by the American Brake Shoe Company.

*See comment Page 152, Part I, re Reference 9.

Materials and Methods

A. THE DUST. Grinding and burning operations create considerable amounts of fine atmospheric dust* in addition to that which is seen as sparks. The dust used in the present experiment was laboriously collected from the atmosphere of the foundry cleaning room to represent the kind of material suspended in the air at the breathing level of the operator. It was collected at a swing-frame grinder station in an area which gave a representative sample of the atmospheric dustiness of the entire cleaning room. A considerable part of this dust was derived from the swing-frame grinders but there was also fume from burning and welding operations in the immediate neighborhood. Also, as pointed out in Part I of this study, chipping operations, stiff-shaft and pedestal grinders and small hand grinders contributed to the general contamination. To indicate clearly the nature and source, therefore, the term "cleaning room dust" has been applied to the dusting materials used in these experiments.

TABLE I.
COMPOSITION OF CLEANING ROOM DUST
USED IN INHALATION EXPERIMENT

Chemical Analysis	Parent Material (used in dusting machine) per cent	Atmospheric Dust (collected in dust room) per cent
SiO_2	6.55	5.95
Fe_3O_4	73.54	68.75
Al_2O_3	6.62	5.10
TiO_2	0.25	0.27
MnO	8.47	7.74
CaO	0.18	0.11
Loss below 110°C.	0.45	3.61
Loss above 110°C.	1.61	5.59
	97.67	97.12
X-ray Diffraction and Petrographic Analysis		
Quartz	3.6	2.3
Cristobalite	0.5	0.4
Corundum	6	4
Glass	2-4	4-8
Organic	1-2	4-8

*See description of operation Page 164, Part I, of this study.

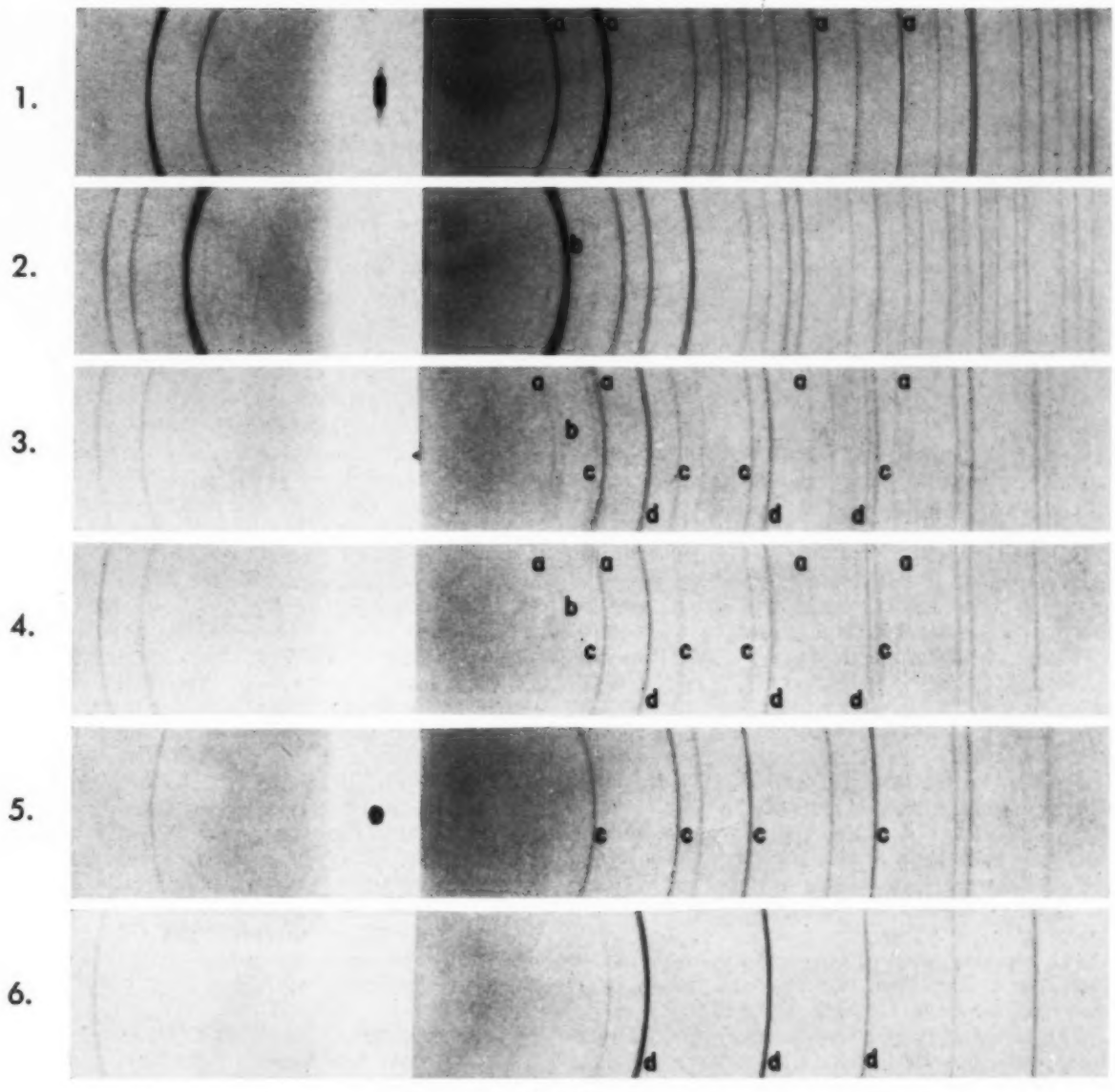


Fig. 1.

(1) Standard pattern for quartz. (2) Standard pattern for cristobalite. (3) Acid insoluble residue of cleaning room dust with sodium chloride added as an internal standard. (4) Acid insoluble residue of cleaning room dust (air-borne sample), with sodium chloride added as an internal standard. (5) Standard pattern for corundum. (6) Standard pattern for sodium chloride

(a) Principal quartz lines. (b) Principal cristobalite line. (c) Principal corundum lines. (d) Principal sodium chloride lines

The results of chemical, petrographic and x-ray diffraction analyses of the dusting materials are presented in Table I. Analyses were made of the parent material used in the dusting machine and also of air-suspended dust collected with an electrostatic precipitator directly from the atmosphere in the dust room. It will be noted that the parent material and the atmospheric dust are similar in composition, after allowing for the moisture and organic matter such as particles of hay, which were a part of the atmospheric dust sample. The free-silica content of the parent material was about 4% and of the atmospheric dust, a little less than 3%. The major constituent was, of course, iron in the form of the magnetic oxide (Fe_3O_4), and this compound plus manganese, which was associated with the iron, comprised more than three-fourths of each sample. No lines corresponding to metallic iron or to the trioxide (Fe_2O_3) were visible in the x-ray diffraction pattern of the dust but a trace of the trioxide was seen on petrographic examination.

Fig. 1 shows a series of x-ray diffraction patterns by which the identity and amount of the crystalline components of the dust were determined. Patterns numbered 3 and 4 represent the acid insoluble residue of the parent material and of the air-borne dust, respectively, plus sodium chloride which was added as an internal

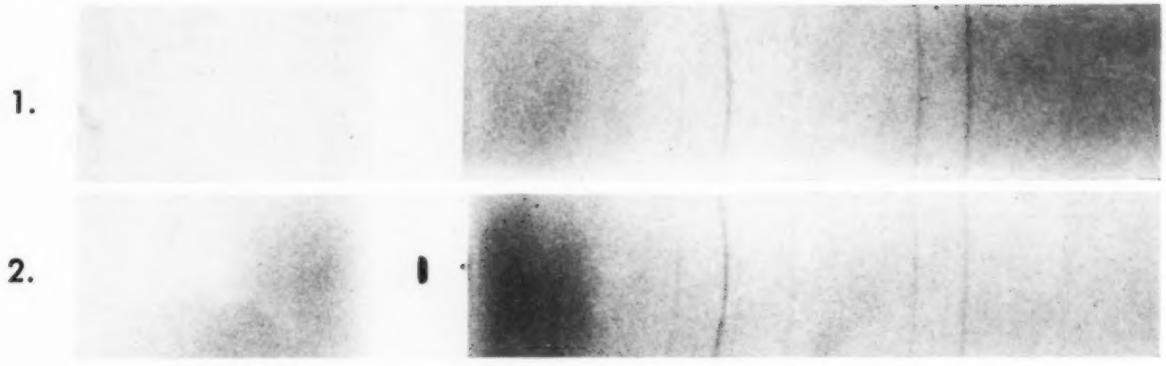


Fig. 2.
(1) Standard pattern for magnetite
(2) Pattern for cleaning room dust

standard; Patterns 1, 2, 5 and 6 represent pure quartz, cristobalite, corundum and sodium chloride. The insoluble residue used in obtaining diffraction Patterns 3 and 4 was prepared by treating the gross dust samples with acid to remove most of the iron. By using the insoluble residue rather than the gross sample the quartz, cristobalite and corundum were estimated much more accurately, not only because these components were concentrated in the residue, but also because fogging of the film, which is produced by secondary radiation when considerable iron is present in the sample and which tends to obscure the diffraction pattern, was greatly reduced. As is evident in Fig. 1, the x-ray diffraction pattern of a sample of mixed dust is a composite of the patterns of the individual mineral components which are present in sufficient amount to register one or more diffraction lines. Thus, the position of the lines shows what minerals are present and the relative intensity of the lines can be employed to estimate the amount of each mineral.

The x-ray diffraction pattern of the cleaning room dust (parent material) is reproduced in Fig. 2 and, for comparison, the diffraction pattern of magnetite is also shown. Since the lines yielded by the cleaning room dust are nearly as intense as those of magnetite, it is apparent that the cleaning room dust is principally magnetite. The background fogging caused by iron conceals the patterns of the minor components.

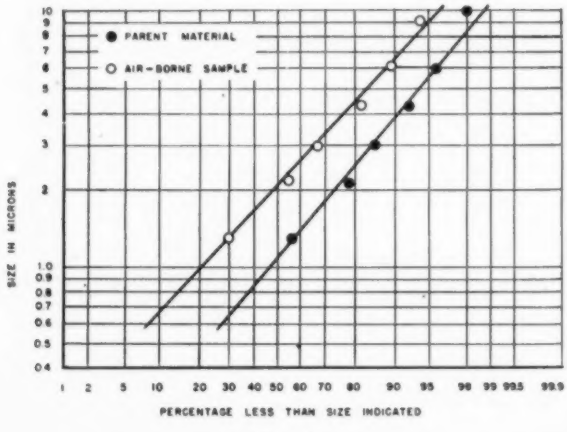


Fig. 3.
Size frequency curves for cleaning room dust

Graphs indicating the particle-size distribution of the parent material used in the hopper and of the air-suspended dust collected directly from the atmosphere of the dust room are shown in Fig. 3. It will be noted that the median size of the parent material is 1.1 microns and of the air-borne dust, 2.1 microns. One would not expect to find a larger median size for atmospheric dust than for the material from which it originates. This condition, however, has been encountered with other dusts. Neither the impinger nor the electrostatic sampler is 100% efficient in retaining fine dust particles and it may be that, in collecting atmospheric samples for size frequency counts, an appreciable proportion of the fine particles is lost. If that is true in the present instance, the true median size of the air-borne dust is lower than the value given by the graph in Fig. 3.

B. EXPERIMENTAL PROCEDURE. The cleaning room dust was used as received and was disseminated into the atmosphere of the dust room by means of a rotating screw which slowly fed the material into a stream of air created by a fan. The fan, located within the room, merely circulated the air without continuously introducing outside air. In this way the supply of material was conserved, a necessary precaution because the amount available for the experiment was limited.

Estimation of the atmospheric dust concentration was made at frequent intervals throughout the course of the experiment by the standard midget impinger technique.[8] Except for single counts of 14 million and 273 million, the dust concentration, as represented by the average value for each month, ranged from 27 million to 202 million particles per cubic foot of air by light field count. The over-all average was 104 million.

Animals of various species, including 75 guinea pigs, 35 rats, and 12 rabbits, were placed in the dust room and remained there continuously. The cloud of atmospheric dust was main-

tained for eight hours a day, six days a week; for the other 16 hours no additional dust was liberated but a small amount was always present in the air. Members of each species were killed after predetermined periods of exposure, in general 2, 4, 6, 8, 12, 18, 24, 30, and 36 months. For the rats, however, owing to their tendency to develop pulmonary infection in old age, the maximal period of exposure was 18 months. The lungs, spleen, liver, and hepatic nodes of each animal were examined grossly and microscopically, and the lungs of a number of the sacrificed animals were also analyzed chemically. Serial chest roentgenograms of the rabbits were made at intervals of two months. Chest roentgenograms of the guinea pigs also were made but no abnormal shadows were seen.

C. TUBERCULOUS INFECTION. The method used in this laboratory for studying experimentally the effect of dusts on the course of tuberculous infection has been described previously.[9] Briefly, it depends upon the use of a particular strain of tubercle bacillus, designated as R_1, which has a degree of virulence for guinea pigs intermediate between that of the standard $H37_{Rv}$ strain, from which it was derived, and the $H37_{Ra}$ dissociate.[10] In normal guinea pigs, the R_1 bacilli produce a self-limited disease which progresses for about two months after infection, with subsequent healing. In guinea pigs exposed to quartz, however, the same infection progresses continuously.[11]

Infection with the R_1 bacilli was established by inhalation according to a technique which has been recorded in detail elsewhere.[12,13] Briefly, guinea pigs are exposed for a fixed period to an atmosphere containing atomized droplets from a suspension of the organisms in a concentration of about 10 to 20 isolated bacilli per oil immersion field.

Results

A. NORMAL ANIMALS. The results of the exposures of normal animals (guinea pigs, rats, and rabbits) are shown in Figs. 4 to 23.

TABLE II.
ANALYSES OF LUNGS OF GUINEA PIGS THAT HAD INHALED CLEANING ROOM DUST

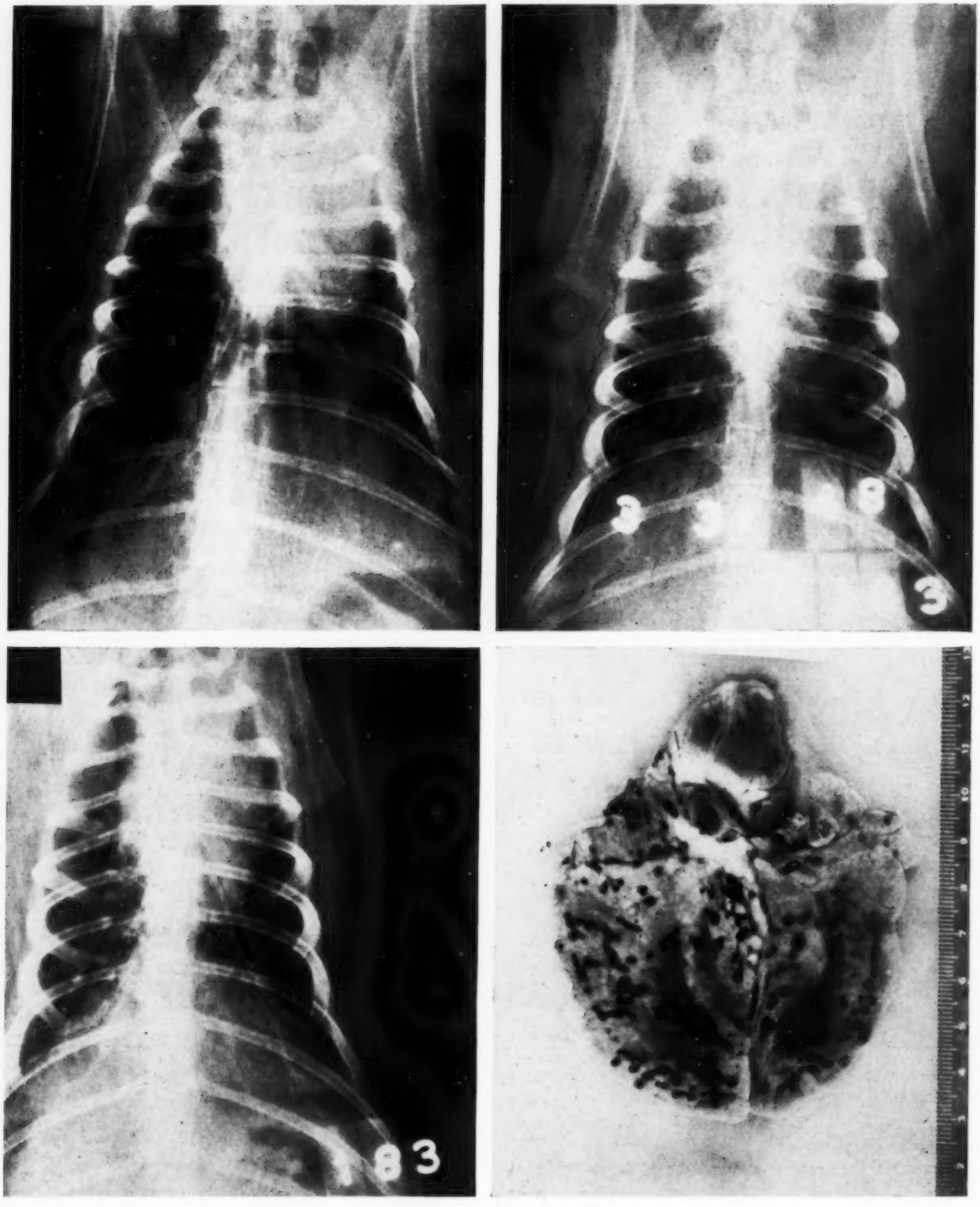
	Duration of Exposure							
	0 months* per cent	6 months per cent	8 months per cent	12 months per cent	15 months per cent	18 months per cent	24 months per cent	30 months per cent
Amount of Ash (per cent of dried lung)	4.6 4.0 4.8 4.6 4.9	4.8 4.2	4.4 4.0	6.1 4.6	5.7 6.6	7.4 6.6	8.9 7.0	8.8 9.1
Total SiO_2 (per cent of dried lung)	0.007 0.012 0.005 0.006 0.004	0.061 0.081	0.085 0.072	0.114 0.066	0.081 0.071	0.104 0.099	0.141 0.139	0.184 0.188
Total SiO_2 (per cent of ash)	0.15 0.29 0.10 0.14 0.09	1.27 1.93	1.93 1.80	1.87 1.43	1.42 1.07	1.40 1.50	1.58 1.98	2.09 2.06

*Normal controls (no dust exposure)

TABLE III.
ANALYSES OF LUNGS OF RATS THAT HAD INHALED CLEANING ROOM DUST

	Duration of Exposure						
	0 months* per cent	4 months per cent	6 months per cent	8 months per cent	12 months per cent	15 months per cent	18 months per cent
Amount of Ash (per cent of dried lung)	3.9 4.3 2.9 3.6 3.3 3.9 3.4	3.8 4.7	2.9 3.1	6.9 5.1	6.8 4.9	8.9 6.4	5.9 6.1
Total SiO_2 (per cent of dried lung)	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	0.06 0.07	0.05 0.04	0.16 0.10	0.14 0.19	0.12 0.13	0.17 0.23
Total SiO_2 (per cent of ash)	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	1.68 1.49	1.79 1.39	2.32 2.02	1.98 3.84	1.34 1.97	2.91 3.68

*Normal controls (no dust exposure)



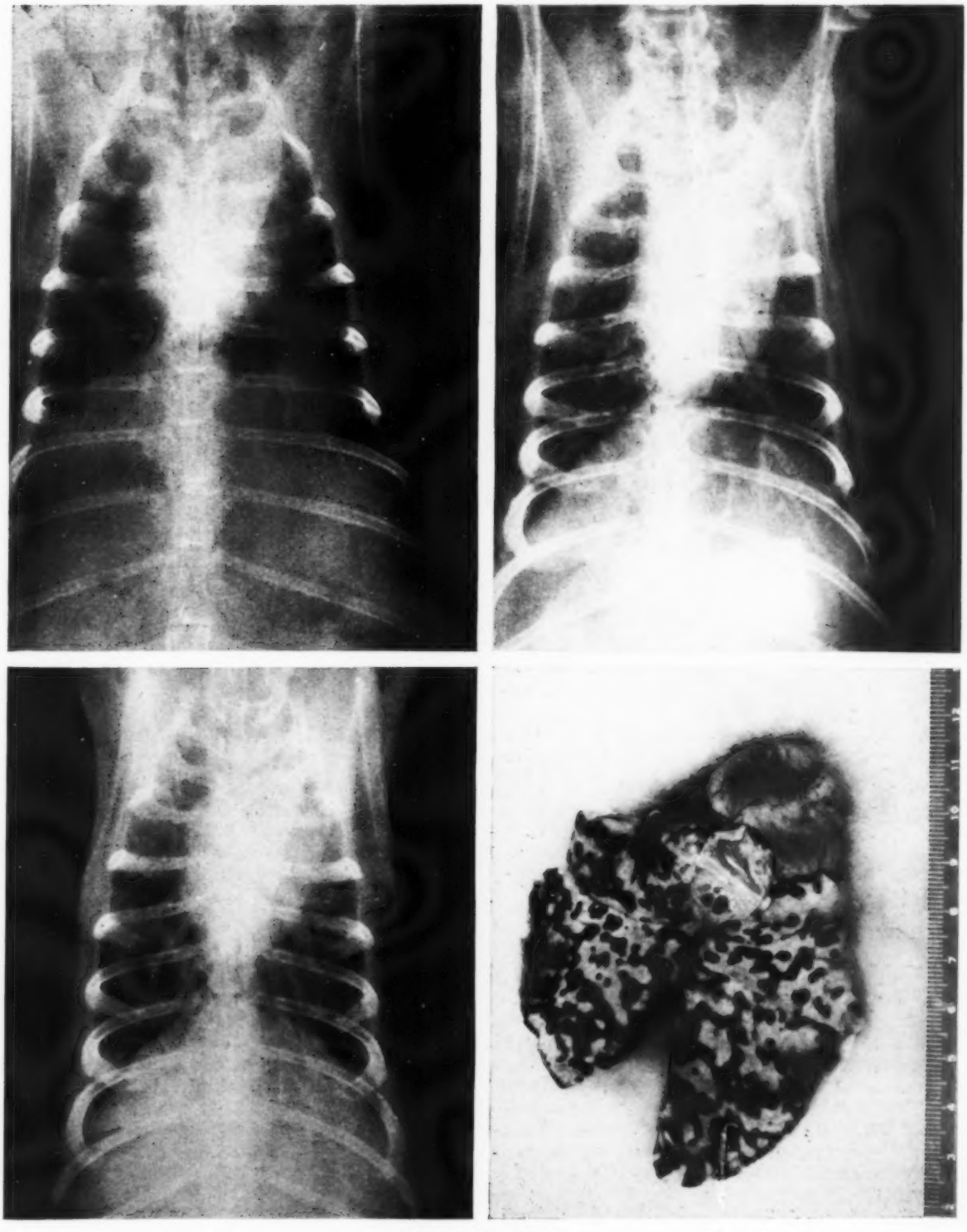
Figs. 4, 5, 6 and 7.

Fig. 4 (Upper left): Roentgenogram of rabbit's chest after 12 months' exposure. The markings are essentially normal

Fig. 5 (Upper right): Roentgenogram of same rabbit's chest after 26 months' exposure. Minute focal densities are now seen throughout both lungs

Fig. 6 (Lower left): Roentgenogram of same rabbit's chest after 36 months' exposure

Fig. 7 (Lower right): The lungs of the same animal, killed at the time of the roentgenogram reproduced as Fig. 6. Note the sharply defined foci of sub-pleural black pigmentation



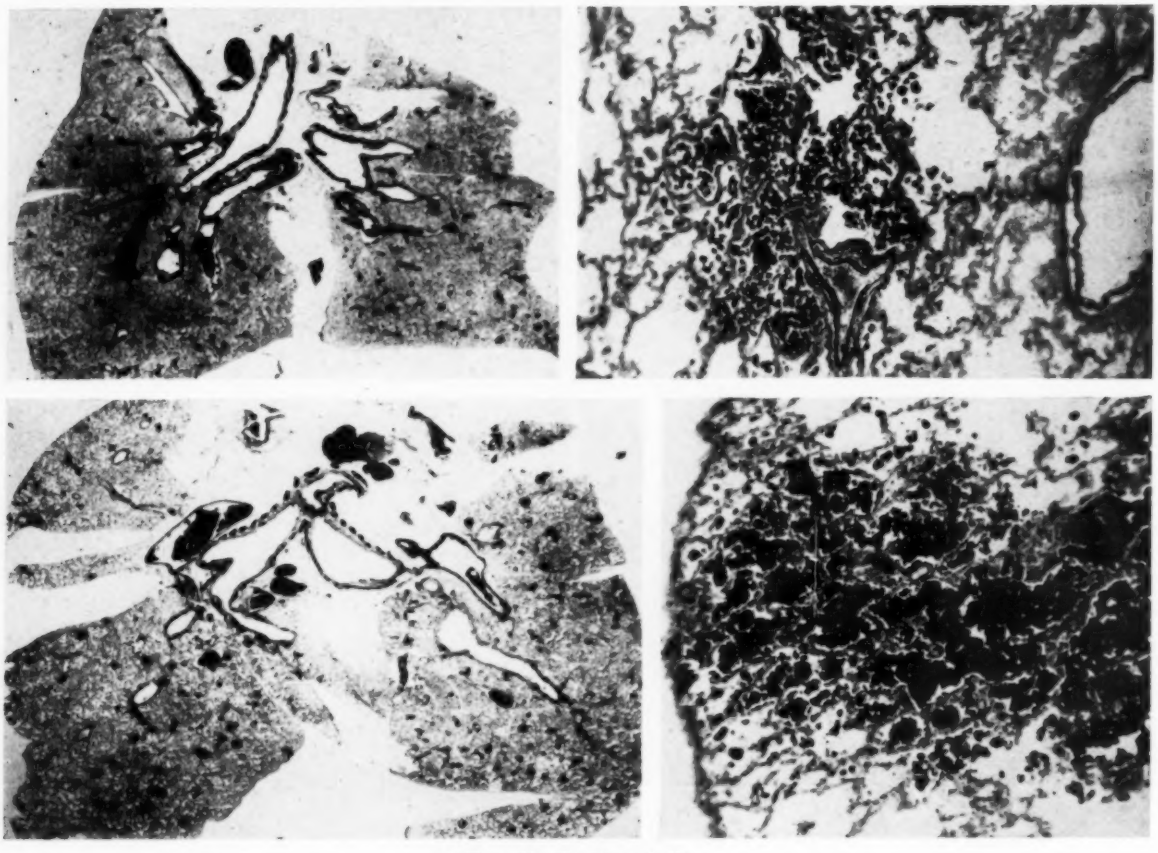
Figs. 8, 9, 10 and 11.

Fig. 8 (Upper left): Roentgenogram of rabbit's chest after 12 months' exposure. The markings are essentially normal

Fig. 9 (Upper right): Roentgenogram of same rabbit's chest after 26 months' exposure. Minute focal densities are now seen throughout both lungs

Fig. 10 (Lower left): Roentgenogram of same rabbit's chest after 32 months' exposure. The focal densities have become more apparent. They are also more apparent than those in Fig. 6, which shows another animal at 36 months. (The roentgenogram of the animal of Figs. 8, 9, and 10 at 36 months was unsatisfactory for reproduction.)

Fig. 11 (Lower right): The lungs of the rabbit of Figs. 8, 9, and 10, killed at 36 months' exposure. The sharply defined foci of sub-pleural pigmentation are larger than in the animal represented by Fig. 7



Figs. 12, 13, 14 and 15.

Fig. 12 (Upper left): Photograph of the histologic section of both lungs of a rabbit killed after 18 months' exposure, the roentgenogram revealing no definite abnormal shadows. Small foci of black pigmentation are scattered throughout the lung. 1 X

Fig. 13 (Upper right): Photomicrograph of one of the foci seen in Fig. 12. Several alveoli are seen to be filled with pigment-laden macrophages. The alveolar walls within the focus are thin and without fibrosis. Note that surrounding alveoli are virtually free of cells and pigment. 100 X

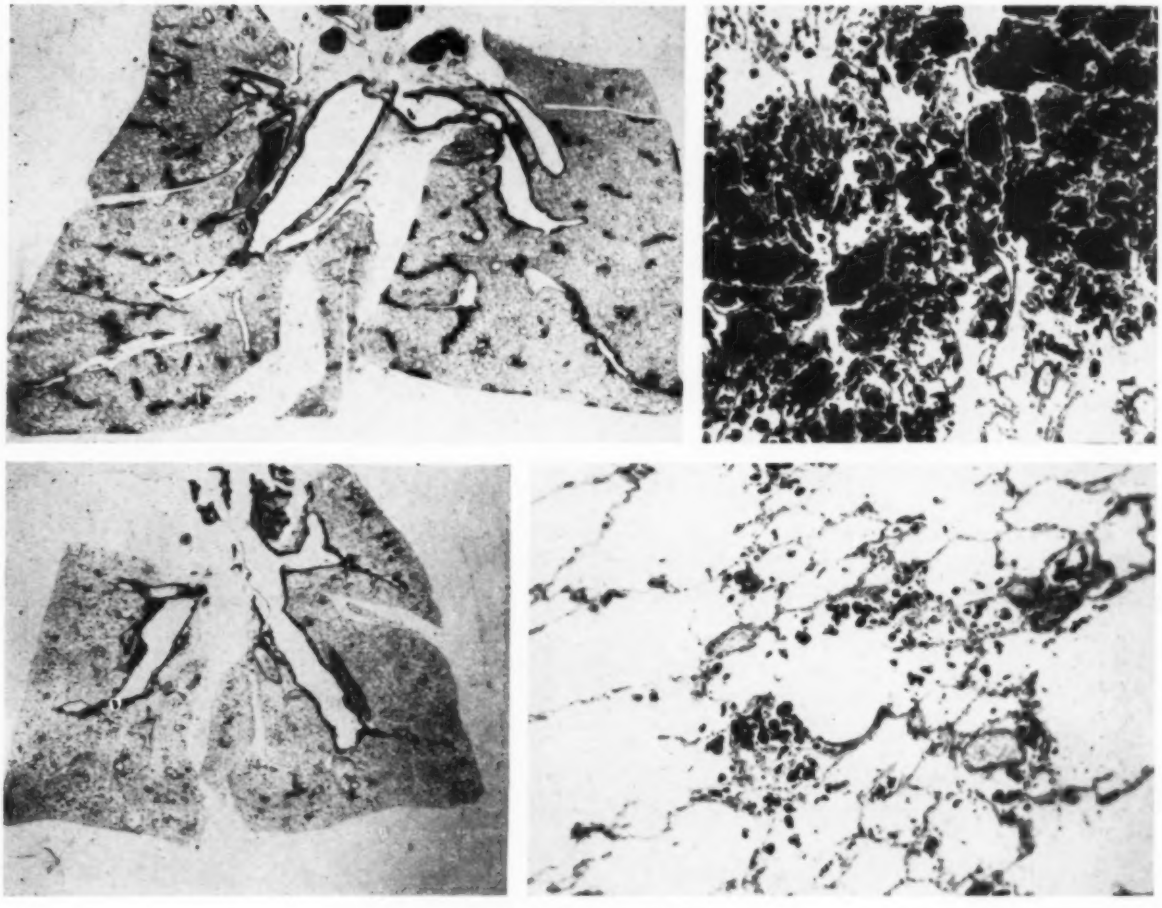
Fig. 14 (Lower left): Photograph of the histologic section of both lungs of a rabbit killed after 30 months' exposure, the roentgenograms showing possible abnormal shadows. The pigmented foci tend to be larger than in the animal killed after 18 months (Fig. 12). 1 X

Fig. 15 (Lower right): Photomicrograph of one of the lesions seen in Fig. 14. Note the increased extent and density of the lesion in comparison with Fig. 13. The incorporated alveolar walls show slight lymphocytic infiltration but no fibrosis. 100 X

The pathological anatomy of the dust reaction was essentially the same in each of the three species. Gross examination of the lungs at all stages of the experiment revealed them to be crepitant and uniform in consistency. Focal and linear areas of black pigmentation were first seen through the pleura in animals exposed for about six months. These areas became larger in the later stages, but were always isolated, with regular, sharply defined margins (see Figs. 7 and 11).

Microscopically, the reaction was seen to consist of simple phagocytosis of the inhaled particles. In the early months the phagocytic cells were isolated and rather evenly dispersed throughout the alveoli (see Figs. 20 and 21). The cytoplasm of the cells, and usually even the nucleus, was obscured by dense, black, accumulated dust particles. After about 12 months of exposure, a tendency for the phagocytes to occur in intra-alveolar clumps was noted. The majority of the cells, however, were dispersed. Subsequently, the tendency for the cells to clump became more pronounced until, at 18 months, the majority of the cells were seen in groups, completely filling three or four adjacent alveoli (see Figs. 12 and 13, rabbit; Figs. 18 and 19, rat). These foci were more numerous under the pleura than in the depths of the lung. In the succeeding months, the foci were observed to enlarge gradually, until 10 to 15 adjacent alveoli were often involved in the animals exposed continuously for 36 months (see Figs. 16 and 17, rabbit; Figs. 22 and 23, guinea pig). While the walls of the involved alveoli showed slight lymphocytic infiltration, in no animal were fibrocytes or collagen deposition noted in the lesions.

The tracheobronchial lymph nodes first showed pigment-laden macrophages at four months. With progression of exposure these cells increased rapidly in number until, at 18 months, the lymphoid tissue was almost completely ob-



Figs. 16, 17, 18 and 19.

Fig. 16 (Upper left): Photograph of the histologic section of both lungs of a rabbit killed after 36 months' exposure. This rabbit is the same animal whose series of roentgenograms and whose gross lungs are seen in Figs. 8 to 11. The foci of pigmentation are seen to be even larger than those visible in the animal killed after 30 months' exposure (see Fig. 14). 1 X

Fig. 17 (Upper right): Photomicrograph of one of the lesions seen in Fig. 16. Note the increased extent of the lesion, in comparison with Fig. 15, and the persistence of delicate alveolar walls within it. There is no fibrosis. 100 X

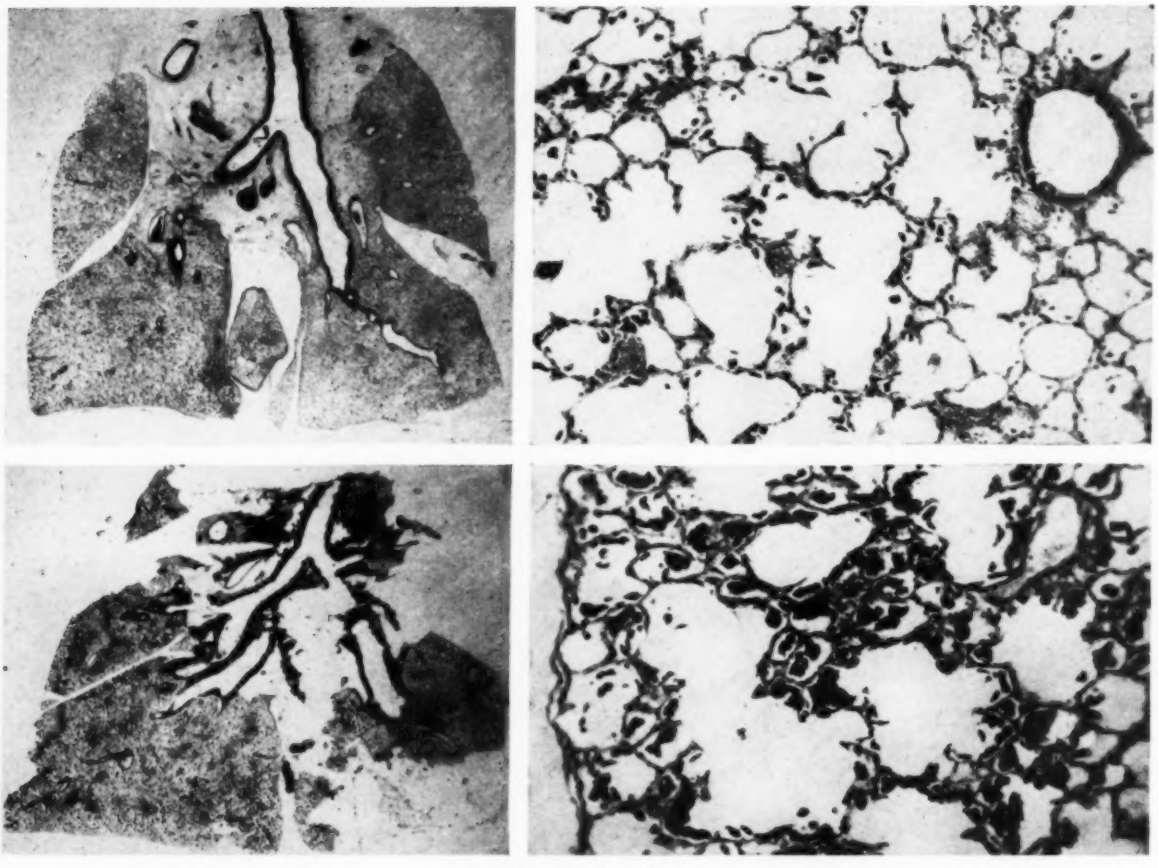
Fig. 18 (Lower left): Photograph of histologic section of both lungs of a rat killed after 18 months' exposure. Minute black foci are seen in all lobes. 1 X

Fig. 19 (Lower right): Photomicrograph of one of the lesions seen in Fig. 18. Note the accumulation of pigment-laden macrophages in several alveoli, and the absence of these cells in surrounding alveoli. 100 X

scured. The nodes became slightly enlarged (see Figs. 12, 14, and 16, rabbit; Fig. 18, rat; Figs. 20 and 22, guinea pig). Fibrocytes and collagen failed to appear even at 36 months.

The results of the chemical analyses of the lungs of two of the guinea pigs and two of the rats killed at each sacrificing date are presented in Tables II and III. Values are given for the total SiO_2 based upon weight of dried lung and of ash, and for the amount of ash. It is apparent that there was a gradual accumulation of silica in the lungs, as is brought out clearly by the values for total SiO_2, percent of dried lung. However, the silica value did not even approach the levels for animals with silicosis produced by the inhalation of quartz dust. In guinea pigs exposed to quartz dust the total silica may be nearly 5% of the dried lung, a value more than 25 times higher than the maximum recorded in Table II. The increase in silica content is not so evident in values for total SiO_2 based upon ash weight because of the dilution effect of the iron oxide, which was also accumulating in the lungs. Unfortunately, the lungs were not analyzed for their iron oxide content because during the first half of the experiment the amount of iron deposited in the lung did not appear to be of particular significance.

The serial roentgenograms in the rabbits revealed no abnormal shadows over the course of the first 18 months of the experiment. Roentgenograms taken at 12 months are shown in Figs. 4 and 8. At 26 months, however, two of five rabbits showed minute focal densities distributed throughout both lungs but most apparent in the caudal portions (Figs. 5 and 9). At 30 months three of five roentgenograms disclosed similar but more definite shadows. Two animals were killed at that time. The gross section of the lungs of one of these is shown in Fig. 14. Sub-



Figs. 20, 21, 22 and 23.

Fig. 20 (Upper left): Photograph of the histologic section of both lungs of a guinea pig killed after 12 months' exposure. There are no obvious foci of pigmentation. 1 X

Fig. 21 (Upper right): Photomicrograph of an area of the lung shown in Fig. 20. Note the rather even distribution of one or two pigment-laden macrophages in most alveoli of the field. 100 X

Fig. 22 (Lower left): Photograph of the histologic section of both lungs of a guinea pig killed after 36 months' exposure. Poorly defined foci and bands of pigmentation are present. 1 X

Fig. 23 (Lower right): Photomicrograph of one of the lesions seen in Fig. 22. While the alveoli here are less uniformly filled with pigment-laden macrophages than in the other species, the nature of the lesion is similar to that exhibited by the rabbits and rats. There is slight thickening and lymphocytic infiltration in some of the associated alveolar walls, but no fibrosis. 100 X

sequently, the three remaining rabbits developed discernible focal shadows, as is revealed in the roentgenogram at 36 months (Fig. 6).

B. TUBERCULOUS GUINEA PIGS. The effect of the inhalation of cleaning room dust on associated R_1 tuberculous infection in guinea pigs was studied under a variety of conditions with respect to the date of infection and to the onset of exposure in the dust room. One group of 50 guinea pigs was infected by inhalation of the organisms and half of the group were placed in the dust room on the day after infection. The remainder, infected at the same time from the same suspension, were kept in normal air as controls. Subsequently, a second group of guinea pigs, 52 in number, was infected using a new suspension of the R_1 organisms. The animals were left in normal air and later half of the group were transferred to the dust room, the onset of dust exposure being two months after infection in 10 animals, four months in eight animals, and six months in eight animals. The remaining 26 animals were kept in normal air as controls. In the first group the influence of the dust inhalation on developing, fresh tuberculosis, and in the second group the influence of the dust on tuberculosis in various stages of development and regression, were observed.

Two experimental and two control animals of the first group were killed at 4, 6, 8, 12, 18, and 24 months after infection. In addition, 12 of the experimental and 11 of the control animals died during the two-year course of the experiment, some from extensive tuberculosis, and others—five experimental and eight control animals—from intercurrent pneumonia. It was possible, however, to evaluate the status of the tuberculous infection in each animal.

Gross and microscopic examination of both the experimental and the control animals of the first group revealed a rather high incidence of spreading pulmonary tuberculosis when compared with the usual course of the R_1 infection. In general,

it has been found that about one out of 20 guinea pigs infected by inhalation of R_1 organisms will develop progressive tuberculosis. In the first group of the present experiment nine of the 25 experimental and nine of the control animals showed extensive and progressive pulmonary tuberculosis. The unusually high incidence of progression in both the experimental and the control animals is attributed to a three-month period of vitamin C deficiency which occurred early in the experiment because of unavailability of fresh vegetables. Since the number of experimental and control animals showing progressive tuberculosis was exactly the same, it is apparent that the dust exerted no adverse influence on the course of the infection.

In the second group—infection first and the dust exposure delayed until two, four, and six months later—the course of the tuberculosis was in accord with the usual trend. Experimental animals were killed at four, eight, and 12 months after onset of the dust exposure. None of these experimental animals showed gross or microscopic evidence of progressive pulmonary tuberculosis. One of the control animals did show progressive disease. As already noted, this phenomenon of progression in control animals has been repeatedly observed in about one of 20 animals, and no significance is attributed to its occurrence in the present experiment.

Comment

THIS investigation demonstrates three important points.

First, inhalation of cleaning room dust by rabbits results in the development, after two or three years of exposure, of radio-opaque densities throughout the lungs demonstrable by x-ray examination. It is clear that these shadows seen in the roentgenograms of the rabbits were not caused by fibrous tissue, since this was conspicuously absent from the lesions. It seems quite apparent, therefore, that the shadows resulted from the deposition of iron oxide, the major constituent of cleaning room dust, which is relatively opaque to x-rays. The shadows are focal, and apparently nodular, simply because the dust was concentrated into foci by lymphatic and phagocytic activity after its deposition diffusely in the lung. This phenomenon has long been recognized by the pathologist, but is revealed on the roentgenogram only when the "inert" dust is itself radio-opaque.

Second, of three species of animals inhaling cleaning room dust for three full years, all have shown a type of reaction which is similar to that produced by various so-called "inert" dusts. The term "inert" has been applied for a long time to industrial dusts to which a worker can be exposed indefinitely without discernible ill effect. Such dusts are in contrast with the "active" dusts which produce nodular or diffuse lesions in the lungs, demonstrable by x-rays after some years of exposure. In the case of workers exposed to the "active" dusts, the shadows noted in chest roentgenograms have been shown to be due to fibrous tissue deposited in response to the presence of the inhaled dust.

Third, the course of tuberculous infection in the guinea pig is not influenced by the inhalation of cleaning room dust. Since numerous investigations have revealed a close correlation between the results of this type of experiment and industrial experience, it is felt that this study strongly suggests that cleaning room employees in the foundry industry do not suffer a predisposition to tuberculosis. The observations recorded in Part I of this paper[4] concerning the incidence of tuberculosis among these workers and its course when it does occur support this experimental evidence.

Summary

A HIGH concentration of atmospheric dust may occur in certain cleaning room operations in the foundry industry. This dust is finely divided and consists principally of iron oxide, accompanied by about 4% of crystalline free silica and by other minor constituents. A quantity of this dust has been collected and used in an inhalation experiment in which normal guinea pigs, rats, and rabbits and tuberculous guinea pigs have been exposed for periods up to three years. Serial chest roentgenograms of rabbits revealed the development of focal, apparently nodular densities throughout the lung fields after about two to three years of exposure. Gross and microscopic examination of the lungs of rabbits in which roentgenographic changes were present revealed round or elongated foci of accumulated dust without fibrosis. The roentgenographic changes were attributed to the fact that radio-opaque iron oxide was the major component of the inhaled dust. Similar foci of accumulated dust, unassociated with fibrosis, were seen in rats exposed for a maximum of 18 months and in guinea pigs exposed for a maximum of three years. The course of R_1 tuberculous infection in guinea pigs was unaltered by exposure to the dust. The foundry cleaning room dust employed in this study should be classed with the group of industrial dusts which are regarded as "inert."

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Section of the Medical Department Industrial Hygiene Laboratory, where many of the dust samples described in Part I of the foregoing study were analyzed

Medical Services in American Industry

I. The Halle Bros. Co., Health Services, Cleveland, Ohio

IN KEEPING with a program of modernization and expansion, the Health Service Department of The Halle Bros. Company, of Cleveland, has been enlarged and streamlined within the past year. The parent organization, one of the country's finest department stores, guided by health conscious owners has offered a medical service to its employees since 1910, when the store had been established but 19 years. One of the founding brothers is still active in the company and is serving as Chairman of the Board.

Personnel

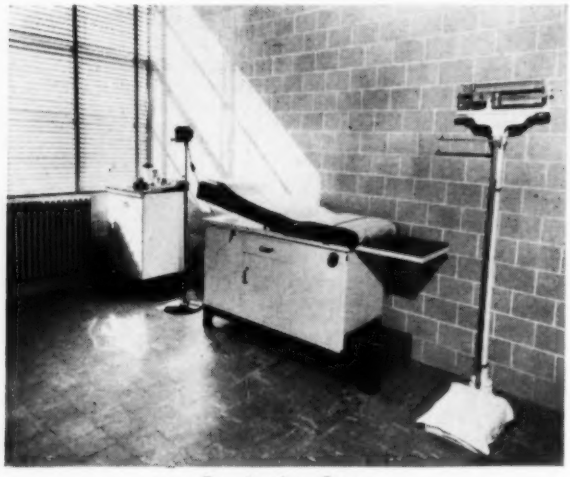
IN 1910 there were 700 employees, but this number has now grown to 3500, of which 77% are women—a figure both not unexpected, and provocative of special health and service problems. Originally one full-time nurse served the needs of the personnel, and there was an "on-call" physician for the rare emergencies. With the growth of the organization additional medical aid was required, and in 1919 a part-time physician was added to the staff. DR. CHARLES A. SWAN, a graduate of Western Reserve University School of Medicine, has been with the Department as Medical Director, part-time, for approximately 28 years, and the present Chief Nurse, MISS BESS SWITZER, has seen the growth of the health facility since 1917. In addition there are two full-time nurses on duty, a part-time dentist, and a full-time registered dental hygienist.

Facilities

WITH the introduction of the dental services early in the 'twenties, more space was made available and a women's ward was created to serve in connection with emergency treatment. The lack of floor space had hampered the development of a health program commensurate with the needs of the enlarging personnel, and it was imperative, therefore, in the planning of the new buildings for the company's expansion, that an adequate area be allocated to a modernized Health Service Department. In 1949 such a plan materialized, so that today, high in the new West Wing building on the eleventh floor, occupying 3700 square feet of space, is a beautiful air-conditioned unit representing a remarkable change from the older department that had but a third of this area. The unit is finished throughout in a dull-glazed grey wall tile and a mottled, attractive flooring; and an immediate four-faceted feeling of warmth, efficiency, immaculateness and welcome strike employee-patient and visitor alike. Occupying a prominent position in the reception room is the Approval Certificate from the American College of Surgeons which Halle Bros. has had since 1934. A neatly-cabineted counter serves in the dual capacity of registration point for incoming employees and as housing for clinical records. The Medical Director's office, overlooking the industrial heart of Cleveland, is spacious and is flanked on either side by an adequately equipped examination room. A 10-bed women's ward, a three-bed men's ward, small rooms for urinalytic procedures and foot soaks, and a good-sized treatment room, all with new equipment, represent the clinic features of the facility. Large corridors and an open area serving as nurses' office lend a feeling of roominess which dispels any impression of hurry even during the busy dispensary hours. Complete unto itself is a three-room dental suite, with a separate office-waiting room, and two operating rooms, one of which currently is equipped with a full dental unit.

This 15-room department is next to a large, beautiful, employees' lounge and card room, and

Left: Bess Switzer, Samuel H. Halle, Walter M. Halle, and Dr. Charles A. Swan. Right: The Treatment Room



Examination Room

Women's Ward

access to the service can be had when desired during worker relief periods.

Program

IT HAS always been the belief of the Halle management that not only is the industrial health department an important part of any large business organization, but that it should be of service primarily to the employees. They believe further that it is sound business policy to protect the health of the personnel, and that the medical department plays an important role in maintenance of the morale of the store staff. Therefore, paralleling this positive concept, the de-

1. Settee
2. Nose, throat and eye chair
3. Chair
4. Nose and throat light
5. Eye lamp
6. Waste can
7. Dental chair
8. Autoclave
9. Sterilizer
10. Nose and throat table
11. Chairs
12. Scales
13. Ward bed
14. Table
15. Desk and files
16. Dental hygienist's desk
17. Towel table
18. Sterilizer table
19. Examination table
20. Doctor's desk
21. X-ray machine
22. Waiting room table
23. Dressing table
24. Refrigerator
25. Dressing table
26. Floor spot light
27. Coat tree
28. Commode
29. Dental unit
30. Waiting room chair
31. Medicine cabinet
32. Dental cabinet
33. Table
34. Nurses' dressing table
35. Side chair
36. Foot tub
37. Laboratory table and sink
38. Dental laboratory table and sink

HEALTH INFORMATION BLANK

As a preliminary to the examination which will be given you by our physician within the first six months of employment you are requested to answer fully the questions on this blank in order that the Health Service Department may be in a position to render you intelligent service in maintaining good health.

Address .....Tel. No. ..... Date.....

Age..... Sex..... Single?..... Married?..... Widow?..... Widower?.....

Height..... Weight.....Pounds } Gained or lost in past 12 months.....

Have you been vaccinated?..... When?..... Are you ruptured?.....

Are you subject to headache?..... Are you habitually constipated?..... Do you have indigestion?.....

Is your appetite good?..... Do you sleep well?..... Do you sleep with fresh air in your room?.....

Have you ever had fainting spells?.....Are you subject to colds or sore throats?.....

Have you any trouble with your eyes?.....Ears?..... Teeth?..... Feet?.....

As far as you know have you ever had the following illnesses? (Give date of each)

Tuberculosis	Diphtheria	Pleurisy .....
Diabetes	Tonsilitis	Pneumonia .....
Scarlet Fever	Rheumatism	Goitre .....
Hay or Rose Fever	Asthma	Major Surgical Operation .....

(Give details) .....

What illnesses have you had in the last two years? State length of each illness

.....

.....

Are you aware of any physical impairment at the present time? Give details

.....

.....Signature .....

partment has been termed "Health Service," rather than Medical Service or Medical Department with the concomitant emphasis on curative medicine or reparative clinical procedures.

The program is a well-rounded one, embracing the features outlined in the following:

PRE-PLACEMENT PHYSICAL EXAMINATIONS are conducted with the objective of accepting every applicant examined through intelligent placement in a type of work he is capable of handling. Rejections are few, being primarily of candidates presenting contagious diseases or "serious" physical impairments. Actively engaged in store work are successfully placed employees possessing physical disabilities. Monthly re-checks are carried out on workers presenting correctible defects, so that the health status of the individual can be improved by medical guidance and motivation toward physical betterment. Periodic physical examinations are offered on a voluntary basis.

TREATMENT of minor illnesses and injuries is accomplished by the nursing staff working under standing orders. The goals of this form of preventive medicine are (a) the avoidance of a serious condition through alleviation and correction of early minor symptoms and findings, and (b) the completion of the work shift by the ill employee when possible through the institution of simple remedial measures or a brief period in the rest ward.

EMPLOYEES presenting illnesses or injuries of greater import are observed, and a constant effort is made to place each one in the care of his family physician—in fact, emphasis is laid on the approach that all personnel are referred for care to their physicians except for minor conditions or occupational injuries. Problems involving length of disability or work restrictions post-illness-absence are discussed regularly with the employees and their personal medical advisers. In the event that specialist care is required or no contact has been made as yet with a private practitioner, recommendations are made.

ALL OCCUPATIONAL injuries are given treatment, although, by virtue of the nature of department store activities, traumatic surgery of an extensive nature rarely is required.

Interesting in itself is the follow-up given employees who have been absent because of disabling illness or injury. A daily report of all absentees is forwarded to the Health Service by the store departments, and employees returning to work after an absence of more than one day because of illness must obtain a pass from the medical department in order to resume regular work.

Workers becoming ill during the work day can be excused only by the Health Service, when a special pass is issued. This allows payment for the time lost.

Name ..... Address..... Tel. .....
Date ..... Height..... Weight..... Age.....
Nutrition ..... General Appearance..... Skin .....
Goitre ..... Glands..... Tonsils.....
Vision Distant Uncorrected .....R.....L..... Color Vision .....
Distant Corrected .....R.....L
Near Uncorrected .....R.....L
Near Corrected .....R.....L
Ears .....R.....L.....Heart .....
Lungs .....Abdomen ..... Hernia .....
Extremities .....Reflexes ..... Blood Pressure.....
Feet .....Urine.....Alb. .....Sugar.....Mic. .....
Physical Rating .....
Recommendations .....
Remarks .....

Physical Examination Form

THE dental service is of interest in that it represents a departure from the orthodox in industrial health services, yet is an activity seen not infrequently in department store medical facilities. Preventive dentistry is emphasized, and the services are executed under the supervision of the Medical Director. The dental surgeon does simple fillings and extractions, but extensive restorative practices, such as the fabrication of dentures or bridges, are not offered. The dental hygienist maintains a full schedule of prophylaxes, and works completely by appointment. Dental x-rays are made for the employees and may be taken to the private dentist of choice. The employees pay for the prophylactic care, in full, and for the other dental work in part only, for management bears the cost of space, equipment, and up-keep. The personnel in these cases, as with medical conditions, are encouraged to seek private dental care for full treatment or restoration. It might be mentioned that the dentist spends, in the main, about two hours daily during the work week, while the dental hygienist is employed full-time.

Customers presenting illnesses or becoming injured while in the store are given immediate emergency care, and then are referred to their private physicians for follow-up attention.

Organization Position

THE Health Service is operated by the Medical Director, who reports to the General Superintendent of the store. In the day-to-day execution of the health program there is a close active cooperation between the Superintendent's office (which maintains personnel functions) and the medical department. Personnel problems with a medical aspect are handled usually by the Health Service after discussions between the Personnel and Medical Directors.

Summary

A MODERN well-conceived health service plan is in operation at The Halle Bros. Company, a leading department store in Cleveland, Ohio.

2. The personnel manning the Health Department is comprised of a full-time nursing staff, a part-time Medical Director, a part-time dentist, and a full-time dental hygienist.

3. Program features of this service include (a) pre-placement physical examinations, (b) medical care of minor illnesses and injuries, (c) observation of and counsel for physical conditions requiring private practitioner care, (d) treatment of occupational injuries, (e) illness-absence study and control, (f) preventive dentistry and prophylactic care, and (g) emergency care for customers becoming ill or injured on the store premises.

4. A progressive management with an understanding of the benefits accruing to employer and employee alike have provided a Health Service that is professionally sound, ethically grounded, and actively is utilized by the store personnel.

MONTHLY HEALTH SERVICE DEPT. RECORD

Date	Non-Occupational Illnesses & Injuries	Occupational Injuries	Examinations	Employees Absent	Report Back to Work	Referred to Private Phys.

Urinary Uranium as a Measure of Exposure Hazard

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FOREWORD: *The purpose of this report is to furnish an interim guide to industrial physicians, industrial hygienists and plant management, and to serve as a preliminary basis for the actual setting up of working standards by an authorized committee. The "recommended values" are based almost entirely on animal experimentation and can in no sense be regarded as final. Any person who may choose to employ the standards suggested in this report must assume full responsibility.*

The Atomic Energy Program was initiated in wartime. Emergency conditions and the need for security regulations made it impossible to set up a systemized distribution of the findings of the many research groups involved. It is still difficult to locate many pertinent articles which received a rather localized distribution. Any omissions in the literature cited were not intentional but may be attributed to our inability to make the survey complete.

WITH the development of atomic energy, the production of uranium has grown to be a large scale industrial process. Since uranium is both toxic and radioactive, particularly in isotopic preparations, the problem of determining the exposures received by individuals handling uranium and its compounds is one of first-order importance. Because of its specificity, the analysis for urinary uranium is one of the most attractive methods of assessing the degree of these exposures. Urine specimens (especially "spot" samples) can be obtained simply and often, without the need of specialized personnel in attendance, and without inconveniencing or alarming the worker. In addition, the uranium content of urine may be determined quite accurately by a number of convenient methods. Quite naturally, the analysis of urinary uranium has been included in the industrial hygiene programs of the many areas of the atomic energy project. To our knowledge, however, there has been no published attempt to assemble the necessary data to provide a basis for the rational interpretation of such analyses.

It is the purpose of this review to consider in detail the various factors affecting the level of urinary uranium.

Metabolism of Uranium

DISTRIBUTION AND EXCRETION: Before discussing the variables affecting the concentration of urinary uranium, it is necessary to review briefly the metabolism of the uranyl ion.* To elucidate the mechanism of the toxicological action of uranium, Dounce, et al,[1] investigated the chemical behavior of uranium under physiological conditions. Their studies demonstrated that very little uranyl ion (UO_2++) exists in solution at pH 7.2. Rather, most of the uranium complexes with various organic and inorganic anions normally present in body fluids. The complexes of uranium with proteinate, bicarbonate, and acetate were investigated in detail[1]; only preliminary studies were made of complexes of uranium with malate, citrate and organic and inorganic phosphates.[2,3] Based on these chemical studies, the metabolism of hexavalent uranium was formulated as follows[4]: In the animal, uranium is carried in the blood principally in two forms: an indiffusible fraction which is protein-bound (about 40%) and a diffusible fraction consisting largely of the uranyl bicarbonate complex (about 60%). These two fractions are in equilibrium, so that removal of the diffusible portion results in a dissociation of the protein-bound fraction.

Under physiological conditions, the uranium in combining with protein causes little or no denaturation.

Cellular damage occurs *in vivo* only where there is insufficient bicarbonate and other organic anions to keep uranium in the form of a diffusible complex ion, i.e., in the kidney tubule. The diffusible bicarbonate complex of uranium is filtered through the glomerulus and as the glomerular filtrate passes through the tubule, bicarbonate ion is resorbed. Concurrent with the fall in bicarbonate concentration, the dissociated uranyl ion is free to combine with active groups on the surfaces of the cells lining the tubules, ultimately resulting in cellular damage.

While these events are taking place within the kidney, the diffusible bicarbonate complex of uranium is leaving the blood stream and entering the extracellular fluid. Thus, uranium appears in the soft tissues for a short time after injection; however, if it penetrates cells, it is not fixed to any appreciable extent.[5] The skeletal system, on the other hand, shows a remarkable affinity for the element. Uranium in the extracellular fluid bathing the bone undergoes an exchange with calcium ions in the surfaces of the mineral phase.[6] Apparently, it forms a very stable linkage with adjacent phosphate groups in the surface of the apatite crystals. The dissociation of this bone-bound uranium is very

This paper is based on work performed under contract with the United States Atomic Energy Commission at the University of Rochester Atomic Energy Project, Rochester, New York.

*Uranyl ion is the only valence form of uranium of physiological interest.[4]

slight, only minute quantities being returned to the circulating fluids.[6]

The distribution and excretion of absorbed uranium may be summarized as follows[5,7-21]: Roughly two-thirds of the dose is excreted very rapidly in the urine. The kidney initially may contain about one-fifth of the dose but this is excreted via the urine quite rapidly. About one-fifth is found in the skeleton, from which it is mobilized slowly. All other soft tissues (including blood) contain negligible quantities. Fecal excretion in the early phases is negligible. After about one month fecal and urinary excretion are almost comparable.

It appears that the urinary system (kidney and urine collectively) is in competition with the skeletal system for the uranium. Young animals which are growing rapidly deposit more uranium in the skeleton leaving a smaller proportion of the dose to attack the kidney.[5] Although alkali administration, by increasing the proportion of diffusible uranium in the blood, will increase the rate of glomerular filtration, it also increases the rate of filtration into the extracellular fluid and deposition in the skeleton so that the distribution between skeleton and urinary system remains unaltered.[5] Alkali infusion does decrease the proportion of uranium which remains fixed in the kidney, increasing amounts appearing in the urine.[5]

RATE OF EXCRETION OF ABSORBED U: The excretion immediately following administration is almost exclusively urinary; negligible amounts are found in the feces.[5,11]

The amount found in urine is directly related to the rate of glomerular filtration of uranium since there is little or no tubular secretion or absorption.[22] In turn, the amount of uranium filtered by the glomerulus is directly proportional to the blood concentration. Since uranium leaves the blood stream *very* rapidly (99% in two hours) the early phase of urinary excretion is of brief duration.[5] However, not all of the material filtered reaches the bladder directly; a variable proportion may be retained temporarily on the lumen surfaces of the tubules. Because of this slight delay, the complete excretion of that uranium which is not actually retained by bone and kidneys takes from eight to 24 hours, most appearing in the first two hours.[5]

Though excretion of U is dependent upon glomerular filtration, the excretion is not particularly dependent upon urinary volume.[22] Therefore, it is the amount of uranium excreted per unit time that is of interest, *not* the urinary concentration. Expressing results on a concentration basis say, as micrograms per liter, introduces an additional variable, that of varying urinary volume. It is preferable to employ a rate basis for reporting results, i.e., γ of U/hr. or γ of U/24 hr. To do this it is necessary to know the time of collection, time of last voiding, and total sample volume.

In normal animals, the percentage of the dose excreted in 24 hours is quite large: mice[11] 50%, rats[5,11] 60%, and dogs[11,20] 70%. Humans also are quite comparable; six patients excreted an average of 73% in the first 24 hours.[7] With little species variation, then, normal animals excrete roughly two-thirds of the uranium absorbed within 24 hours.

It should be stressed, however, that variations in acid-base balance markedly affect the amount excreted. Such variations do not materially alter the distribution between the skeleton and the kidney-urinary system; rather, these variations determine to what extent the uranium which reaches the kidneys is initially fixed in that tissue.[5] Alkali infusion kept kidney *fixation* to less than 1% of the dose. Ammonium chloride, on the other hand, increased the deposition in the kidney to as much as 72%. Correspondingly, alkali infusion elevated the urinary *excretion* to as much as 75% and acid-feeding reduced it to as little as 3%.

In the discussion below, the proportion of absorbed uranium which is excreted via the urine is assumed to be two-thirds. This assumption will be in error in cases of acid-base disturbance. The error introduced by alkalosis is necessarily small, but even a mild acidosis may be expected seriously to reduce the amount excreted. Because of this, it would appear advisable to obtain an estimation of the urinary pH at the time of voiding.

Samples with a pH below normal should be discarded as unreliable.

ROUTE OF ENTRY. From the industrial hygiene point of view, only one route of entry is of great importance. By far the greatest number of industrial exposures are due to the inhalation of dusty atmospheres of uranium. By this route considerable material may be absorbed. Taken orally, only a small amount is absorbed, viz., less than 0.5% of even the most soluble compounds.[23] Though the percutaneous absorption of uranyl salt from an ethereal solution applied directly to the skin is possible, again the percentage absorbed is quite small (based on a comparison of LD 50's) less than 0.5%.[24] The percutaneous absorption of dry uranium salts is obviously even more problematical.

Fortunately, by all routes of entry, *absorbed* uranium follows the consistent pattern of distribution and excretion described above. However, one point in this connection should be emphasized. The various uranium compounds are not absorbed equally well from the lung. Though soluble compounds are absorbed promptly, the continued exposure to dusty atmospheres of insoluble compounds results in a gradually increasing concentration of uranium in the lung and in the pulmonary lymph nodes.[25] This stored uranium will continue to be absorbed slowly resulting in a chronic, low-grade exposure even after the exposure to uranium dust ceases.

Calculation of "Safe" Urinary Values

STATEMENT OF PROBLEM: From the above it is evident that the problem of interpreting an analysis of urinary uranium involves an evaluation of four variables. The urinary value may represent the excretion of uranium derived from: (a) the absorption of soluble uranium salts inhaled in the period immediately preceding sampling, (b) the absorption of insoluble material accumulated in the lung from exposures over the past months, (c) material deposited in the kidney over the past few weeks, and (d) uranium being mobilized slowly from the skeletal system.

Given a single "spot" urinary uranium analysis, it is difficult if not impossible to calculate the exposure hazard. It is necessary to have at hand correlative data. In the discussion to follow each of the four variables will be considered separately and in detail. It will be seen that the problem is greatly simplified by a careful choice of sampling time and technique.

URINARY EXCRETION OF SOLUBLE URANIUM COMPOUNDS RECENTLY INHALED: Urinary excretion of soluble uranium compounds recently inhaled depends on two rate functions: rate of absorption from the lung and rate of excretion of the absorbed material. The rate of excretion has been discussed adequately above. A search of the available literature revealed no data dealing specifically with the *rate* of removal of soluble U salts from the lung. From a consideration of the rate of solubility of U salts in serum[4] it is to be expected that absorption would be very rapid. Proof of this view is the observation that there was *no* accumulation of U in the lungs of animals exposed to atmospheres containing $UO_2(NO_3)_2 \cdot 6H_2O$ up to 2 mg U/m³ (Ref. 26) for a period of two years. Apparently, absorption kept pace with the day-to-day exposure. The toxic response of animals to the inhalation of high dust levels of $UO_2(NO_3)_2 \cdot 6H_2O$ also offers confirmatory evidence. The onset of kidney injury follows a time course very similar to that observed when the salt is *injected*[27] parenterally.

We may conclude that there is very little delay in the absorption of soluble U salts once inhaled. Certainly one day after exposure the absorption of soluble material still remaining in the lung must be negligible.

We may expect from these considerations that urine samples collected on successive days following an exposure would show decreasing quantities in the urine. This has been actually observed with studies on plant personnel.[34] To obtain an estimate of recent exposure to soluble material, therefore, the best time for collection of the sample is at the conclusion of the day's employment, or better still, at the conclusion of the week's work, Friday evening.

A rough calculation may be made to indicate the maximal quantity of urinary uranium due to recent exposure in an individual working eight hours daily in an atmosphere containing the maximal allowable concentration (MAC) of soluble uranium dusts.

Assuming:

Breathing rate is 12m³ per eight-hour working day.

The MAC is 50 γ U/m³.

Retention in the lung is 80% of that breathed.[28]

Two-thirds of that absorbed is excreted in the urine.

Then,

$$12 \times 50 \times 0.80 \times 0.66 = 320 \ \gamma \text{ U/24 hr.}$$

It seems reasonable, therefore, that any individual showing a greater excretion than 320 γ U/24 hour is being exposed to excessive amounts or uranium *or* is excreting uranium previously stored in the lung, kidney, or skeletal system.

URINARY EXCRETION OF INSOLUBLE URANIUM DEPOSITED IN LUNG: The accumulation of insoluble compounds of uranium in the lung presents a special hazard. In this case, it is not that uranium has shown chemical toxic effects on the lungs (or the kidneys). Rather, the limit of accumulation in the lung is set by radiological considerations due to the radioactivity of natural uranium. The maximal concentration considered safe has been calculated to be 25 γ U per gram of tissue.[25] With enriched isotopic preparations of uranium, having a greater radioactivity than the natural mixture this figure would be correspondingly lower. Assuming the adult human lung to weigh approximately 1 kg., the maximal permissible accumulation of insoluble uranium is approximately 25 mg. U.

There is a critical insufficiency of data available on the rate of removal of insoluble dusts from the lung. It has been variously estimated for UO_2, a representative material, that the half-life in the lung is between 50 and 200 days.[25] These data represent only a very few animals. Taking 100 days as an approximation, this rate would represent a removal of about 0.7% of the deposited material per day.

It is understood that not all of the material so removed is absorbed. If about half the material disappearing from the lung is dissolved by body fluids and thus absorbed, the maximal amount of uranium to be expected in the urine would be of the order of 60 γ U/24 hours.

Thus:

$$\frac{25000 \ \gamma \times .007 \times 2/3}{2} = 58 \ \gamma \text{ U/24 hr.}$$

(deposit) x (rate of removal) x (excretion factor)

Since the half-life of insoluble uranium in the lung is rather long, this excretion rate should persist for weeks, even if further exposure were prevented.

THE URINARY EXCRETION OF URANIUM DEPOSITED IN THE KIDNEY: The principal toxic effects of uranium are concerned with its action

on the kidney. Therefore, with this tissue, it is toxicological rather than radiological effects which must be considered in determining the maximal "safe" concentrations. When lethal quantities of uranyl salts are injected into rats the highest concentrations found in the kidney are only 40 to 50 γ U/g (Ref. 5). Since this concentration causes sufficient injury to the kidney to result in the death of the animal, the maximal safe concentration must be considered to be much less than 5γ U/g, probably 2-3 γ U/g. This view is supported by analyses of the U-content of kidneys of animals exposed to dusts of $UO_2(NO_3)_2 \cdot 6H_2O$.[25]

Once deposited in the kidney, uranium has been shown to be excreted fairly rapidly in all species tested. No half-life values are available but from present data it appears that the half-life is of the order of four days.[5]

This corresponds to an excretion rate of about 1/6 per day.

Assuming the adult, human kidney to weigh approximately 300 g.:

$$300 \times 2 \times 1/6 = 100 \ \gamma \text{ U/24 hours.}$$

$$\downarrow$$

tentative "safe" U content.

If exposure ceased, however, this rate would fall to 30 γ U/24 hours after one week because of the rapid depletion of the deposited uranium.

THE URINARY EXCRETION OF SKELETAL URANIUM. A fair proportion (5-20%) of absorbed uranium is deposited in the skeleton from which it is mobilized slowly.[6,29-33] The distribution of the metal throughout the skeleton is not all uniform; highest concentrations are found in the metaphysis, periosteal and endosteal surfaces.[29-33]

No chemical effects have been reported as a result of such deposited material.[34] The best of available data would indicate that the hazard of skeletal uranium stems from its radioactivity. Thus the maximal concentration which can be considered "safe" is 25 γ U/g or less.[25]

Current information is lacking in long-term data, but up to a few months the excretion rate of skeletal uranium has been reported to be between 0.5 and 8% per day, averaging about 1%[10,11,31]

With these data, assuming the adult human skeleton to weight about 7 kgm., the maximal urinary uranium derived from the calcified structures may be calculated:

$$7000 \times 25 \times .01 \times 2/3 = 1{,}166 \ \gamma \text{ U/24 hr.}$$

$$\downarrow$$

maximal permissible content

This excretion figure is surprisingly high and is approaching that amount shown to produce just detectable kidney injury in humans.[7]

RECOMMENDATIONS: Gathering together the calculated maximal values which were based on separate consideration of each of the four variables concerned, the following Table is obtained:

Source	Max. Excretion
	γ U/24 hr.
Mobilization of Lung U (Insoluble U dust)	60
Mobilization of Kidney U	100
Inhalation of Soluble Compounds	320
Mobilization of Skeletal U	1,166

At first glance, this compilation represents quite a range of "safe" values. Upon further reflection, however, it will be seen that *one* value, that obtained from the inhalation of the MAC of soluble material, 320 γ U/24 hour, is really the limiting case.

The MAC has been chosen to insure that even continued exposure would not result in detectable kidney injury. Therefore, deposition in kidney could not reach the danger point unless the daily level of 320 γ U/24 hour had been exceeded.

Similarly, although the radiological limit for bone would permit an excretion of over 1000 γ U/24 hours, this amount is well over the nephrotoxic level set by the MAC. Skeletal accumulation must not be permitted to reach the point of radiological danger, since it might prove injurious to kidney tissue.

We are left with an absolute maximum of 320 γ U/24 hours. What about the lower limit set by the mobilization of insoluble compounds accumulated in the lungs? Fortunately, it is easy to distinguish this from the absorption of recently inhaled soluble material. A urine sample taken Friday evening at the conclusion of the day's work would contain uranium both from soluble and insoluble U dust in the lung as well as from the skeleton. A sample taken Monday morning upon arrival, however, would be almost free of recently absorbed, soluble material. Unfortunately, since both lung-stored and skeletal uranium have approximately the same rate of mobilization there is no convenient means of differentiating between them. This creates a real problem, since an excretion of 300 γ U/24 hours would be perfectly safe if one could be certain it all originated from the skeleton. Because of this, the limit must be set by the maximum permissible if all were derived from lung, namely, 60 γ U/24 hours.

However, this figure may be revised upwards slightly. It seems very unlikely that the urinary uranium could be exclusively derived from lung. Certainly by the time uranium accumulated in the lung, there would be considerable quantities also deposited in the skeleton.

Because of the unknown variables involved and the paucity of data available, it seems worthwhile to add a small safety factor in setting the maximum permissible urinary value.

From these considerations, the following tentative recommendations may be made:

	Fri. Eve. Sample	Mon. Morn. Sample
	γ U/24 hr.	γ U/24 hr.
Safe	0-50	0-50
Probably Safe	50-250	50-100
Possibly Unsafe	>250	>100

CRITIQUE: The values recommended as "safe" in the preceding section have been based almost entirely on the results of animal experimentation. Additional support for the choices made can be obtained from two studies made several years ago on plant personnel.

"Friday evening values." Friday evening values are indicative of that day's exposure (i.e., Friday's) to soluble compounds of uranium. The level has been set to insure against kidney injury. Consequently, to test the validity of our choice of 250 γ U/24 hours, data bearing on the relationship between urinary excretion and kidney-damage must be examined.

In one study of humans with urinary values of from 300-2000 γ U/24 hours no detectable kidney injury was observed, despite the complete clinical study made using the most delicate tests known.[7] Though these data represent only single exposures, there is a considerable factor of safety between our chosen limit of 250 γ U/24 hours and the observed value of 2000 γ U/24 hours shown *not* to be injurious.

In one study of plant personnel[35] urine samples were taken during working hours and hence correspond roughly to our "Friday evening values." In the series, 12 men were shown to be excreting more than 100 γ U/1 (approximately 150 γ U/24 hours) with no *significant* detectable kidney injury as measured by urinary catalase and protein. Of the 12, three showed slightly elevated urinary catalase values on at least one occasion, but "it was impossible to investigate these three cases further to attempt to confirm or refute (the) .... possibility .... (that) .... minimal active tubular damage might have been occurring."

In lieu of more precise data, the value of 250 γ U/24 hours seems neither too high nor inordinately low. It may be necessary to revise this figure as more experience is gained.

"Monday morning values." In the second study of plant personnel[36] no information was given on how exposure ratings were made, but the statement is made, "Many of these individuals were believed to have had about as heavy exposure to uranium as any personnel in this country. Exposure was chiefly to the UF_4 salt. For analysis these men have been classified for us by their supervisors into four groups according to their probable exposure to uranium."

Collection of samples was made either Sunday evening or Monday morning with adequate precautions to prevent contamination. These data, then, represent a test of the recommended "Monday morning values." It should be noted that these data, presented in the accompanying Table are expressed as γ/liter rather than γ/24 hours. If the data are corrected on the assumption that the average 24-hour urinary output is 1.5 liters only two of 67 samples exceeded the recommended 100 γ U/24 hour limit. Both of these were observed in the group with "heavy" exposure.

Group	No. of Samples	Av. U Conc'n.	No. of Samples Containing $>100\gamma$ per liter
		γ/1.	
Heavy	21	75	3
Moderate	26	46	2
Light	11	16	0
Incidental	6	<5	0

It is noteworthy that of the five individuals excreting a concentration greater than 100 γ/1, none exceeded the limit more than once though samples were taken three to four times from each. It may be concluded that the recommended value is not unreasonably low. Individuals with admittedly "heavy" exposure only exceed this limit occasionally. The question arises, is the limit low enough?

It can be reasonably assumed that the limit of 100 γ/24 hours is low enough to preclude active kidney injury. The problem then is one of evaluating the long-term excretion in terms of lung and skeletal deposition. In the calculations, the mobilization rates were assumed to be such that uranium in lungs and the skeleton has a half-life of approximately 100 days.

Data testing this assumption are available on only one individual.[36] This man, said to have the "heaviest" exposure of the group, was employed for over two years in "burning out" crucibles and castings. Following termination of exposure, his urinary excretion of uranium was studied for eight months. The urinary concentration fell exponentially with time and, though the authors did not calculate the value, it is evident that the biological half-life of uranium accumulated in this individual was of the order of 60-70 days. This would indicate that, if our assumptions err, the error is on the side of safety.

Uranium is widely distributed throughout the earth's surface and is certain to be found in food.[37] Of some importance, therefore, is a consideration of the "normal" uranium content of urine. Extensive studies have not been made, and because the amounts found are extremely minute, there were attendant analytical difficulties. It may be stated, however, that normal individuals not exposed industrially excrete less than 5 and probably less than 1 γ U/1.[35,36,37,38]

Collection and Analysis of Samples

METHODS. Because the quantities of uranium in urine are necessarily small only two methods of analysis possess sufficient sensitivity: spectrographic and fluorometric.

Although uranium is not a particularly suitable element for spectrographic analysis, methods have been devised which increase the sensitivity of the technique markedly.[40] The main disadvantage of this type of analysis is the high initial cost of equipment. Where spectrographic equipment is available, however, the cost of operation is very low, the number of samples which can be prepared by a single worker is

large, the precision is adequate, and no preliminary purification of the sample is required.

Because of the high cost of spectrographic equipment, perhaps the most convenient means of determining urinary uranium is by fluorescent measurement. A number of relatively inexpensive instruments have been devised which permit the accurate analysis of extremely minute quantities of uranium.[41,42] If no preliminary purification of the specimen is made, the cost of analysis is quite low. However, there are present in urine a number of quenching substances which introduce a variable negative error of from 10 to 20%.[41,42]

It is not the purpose of this review to compare and evaluate the methods of uranium analysis. For a more complete treatment of the subject, the reader is referred to the original literature which is quite extensive.[40,42]

Since the quantities of uranium by analyses are extremely minute, very extensive precautions must be taken to insure against possible contamination regardless of the final method of analysis. The analytical laboratory should be set up if possible at some distance from the nearest site of uranium production.

Special air filters should be provided for the laboratory and continuous checks should be run to insure against chance contamination of the analytical area.

COLLECTION OF SAMPLES: As noted in the preceding sections, any program of plant survey should include samples taken immediately following exposure as well as those taken several days after the last exposure to gain information on both the exposure level and the extent of body retention. It would seem that the most convenient times for sampling would be at the conclusion of the week's work on Friday evening and at the beginning of the week's work on Monday morning.

It is necessary that great precaution be exercised in the collection of samples to prevent chance contamination. Because of the small amounts involved one small speck of uranium dust is sufficient to ruin a "spot" urine sample. It is recommended that the personnel being tested furnish samples only after a complete shower and a change from work clothing. The samples should be collected in a dust-free area, preferably under supervision. The collection vessels should be scrupulously clean (see following section) and kept tightly stoppered before and immediately after collection of samples. A part of the specimen should be taken immediately for the determination of pH and if it exhibits a pH of less than 5.5, it should be discarded as unsuitable.

As indicated in previous sections the ideal method for reporting results is on the basis of excretion rate. To do this, it is necessary to know the time of last voiding as well as the total volume of the specimen.

STORAGE AND SHIPMENT OF SAMPLES: If at all possible urine specimens should be analyzed immediately for uranium content. As is usually the case, however, it is necessary that the specimen be shipped to another area for analysis. Under these conditions, the following procedure is recommended.[39]

Two-ounce brown bottles of rectangular shape are most suitable specimen containers. Never are more than two ounces of specimen required for analysis and the small containers are more convenient and economical to ship and are less subject to breakage. Before shipment the containers are cleaned thoroughly with soap and water, soaked overnight in chromic-sulfuric cleaning solution, soaked one day in diluted nitric acid and finally rinsed thoroughly in distilled water. The bottles are dried by inversion overnight in a dust-free atmosphere. Then, 100 mg. of citrate buffer (942 parts of trisodium citrate, 58 parts of citrate acid, and one part thymol) and 2 ml. of toluene are added to the dry bottles and the screw caps tightened. Corks are included in the shipping box, wrapped in clean paper. After filling, the bottles are sealed for return shipment with both the corks and screw caps. This insures against leakage and prevents contact between the specimen and the metal cap. Such caps are difficult if not impossible to decontaminate.

The citrate buffer aids in preventing the precipitation of basic phosphates and the adsorption of the minute quantities of uranium present. The toluene and thymol retard bacterial growth. When not in transit, the specimens should be stored in a refrigerator.

Future Research

IN SPITE of the relatively enormous amount of data available on the pharmacology and toxicology of uranium, it has been difficult to set down "safe limits" for urinary uranium with the degree of certainty desirable. The values suggested must therefore be regarded as tentative and subject to revision as more information becomes available.

To permit the assignment of more reliable maximal urinary uranium values, further data are required on four major problems:

1. The "Friday evening value" which represents principally a measure of current exposure to soluble compounds is based on two assumptions (a) that the MAC at 50 γ U/m^3 will insure against any nephrotoxic effects, and (b) that the lung retention of soluble uranium dusts averages 80% of that inhaled. Obviously, the recommended maximum is no more reliable than the recommended MAC. Apart from the reliability of the MAC, the retention figure chosen was entirely arbitrary. Lung retention data for uranium or any other substance for that matter is practically non-existent. Studies of lung retention are certainly desirable. With such studies it might be necessary to revise the recom-

mended "Friday evening value." The revision will not be serious, however, for the error can hardly be greater than 50%.

2. The limiting case in the selection of the "Monday morning value" is the rate of absorption of relatively insoluble compounds of uranium accumulated in the lung. Very little data are available on this crucial problem. Further study is urgent.

3. Although separate studies on the rate of mobilization of skeletal uranium have been in good agreement, they suffer from the fault that the experimental period investigated was never longer than a few months. It seems possible that the mobilization rate might not remain constant over longer periods of time. While this problem is not of immediate interest in selecting the maximal urinary value, it is of considerable importance. It has been suggested that accumulation of uranium in the skeleton might prove to be a radiation hazard and that skeletal retention be kept below 25 γ U/gm. of bone. It has been shown above that this accumulation if uniform through the whole skeleton would lead to an excretion rate of over 1000 γ U/24 hours. Such a condition could never occur since the MAC does not permit a daily absorption of that much uranium. Thus, if the mobilization rate for skeletal uranium can be better established, the radiation effects in this tissue may be eliminated as a hazard.

4. Finally, it would be desirable to obtain more information on plant personnel. Large-scale experiments, however, are not required. Rather, small-scale, carefully controlled studies are most desirable particularly with respect to the following problems:

(a) A direct, simultaneous determination of dust levels in the plant atmosphere and urinary excretion of a few individuals engaged in representative industrial operations would be the best possible means of testing the recommended "Friday evening value."

(b) Clinical studies with emphasis on tests of kidney function on any individuals found to be excreting as much as or more than the recommended limit of 250 γ U/24 hours would be most valuable.

(c) Any individual who, following long-term exposure, terminates this exposure and is still available for study should be tested for urinary excretion over a long period to determine the half-life of uranium retained in the body with more certainty.

Summary

THE general metabolism of uranyl ion is reviewed briefly. Factors influencing the urinary excretion of uranium are discussed in detail. Based on known facts, the maximum concentration of urinary uranium which may be considered safe is calculated. Collection of urine specimens, storage and shipment of samples, and methods of analyses are also discussed. Finally, a suggested program of future research is presented which would aid in obtaining a more accurate evaluation of urinary uranium values.

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The Contributions of Vacations to Employee Health

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TO ENABLE the employee to be more productive and better satisfied for the coming year is the motivation for the vacation policies practiced by many industrial concerns in the United States. It is thought that the gain in rest and relaxation resultant from the vacation will give him renewed incentive in returning to his job. Typical of the general sentiment is the following, "Recognizing the fact that we all need a chance once a year for rest, recreation and change of scene, if we are to keep in good health and be efficient in our work, vacations with pay for all.... (employees) were inaugurated in 1908."[1]

The trend toward providing vacations with pay has gained increasing momentum in the past half-century, with a temporary setback during the depression years. In 1937 only one in four manufacturing establishments provided paid vacations for plant workers, while in 1946 about three out of four manufacturing plants had formal paid vacation plans for their workers.[2] With World War II, vacations for factory workers began to be accepted as standard practice, and vacations with pay were given in lieu of wage increases because of the wage-price freeze.[3] After the war there was a definite shift toward the policy of mass vacations where an industrial plant would close down for one or two weeks, permitting all employees to take their vacations at that time. While not so satisfactory in general to employees and local resort operators, as well as transportation companies, this plan had certain advantages to management, wherein personnel problems in connection with vacations were eliminated and time was provided for building repairs and the like.[4] Now that a buyers' market has returned, however, mass vacation plans are not so popular, owing to the fear of losing business during the shut-down.[5]

The vacation policy at the Oak Ridge National Laboratory gives a paid vacation to all employees meeting the eligibility requirements of six months of continuous service for one week's vacation, or one year's service for two weeks' vacation. The vacation can be taken at the time desired, in so far as this can be worked out with supervisory personnel in terms of maintaining the work schedule. Under the present procedure, it is optional with the employee as to whether the vacation consists of two consecutive weeks or one week at a time. Of interest in connection with vacation policy were two cases found in the study, one of whom had his first vacation in three and one-half years, and the other of whom, a 60 year old machinist, had had only two vacations with pay during his long working experience.

The work covered in this document was done under the auspices of the Atomic Energy Commission.

The Study

SINCE the Health Division of the Laboratory has as its goal the attainment and maintenance of maximal health for each employee, it was decided to investigate the actual health benefits to the employees deriving from their vacations. Following are questions typical of those originally posed. Do vacations actually do what they purport to do in refreshing the employee so that he returns to work with renewed vigor? Is there a single type of vacation which contributes more than others to the improved well-being of the employee? Does the fact that the employee on his vacation turned to a different type of activity from that which he normally pursues help to make the vacation successful from a health standpoint? Does the degree to which the employee was able to fulfill his desires for an ideal vacation have any bearing on the vacation benefits? With consideration given to these questions, the study was outlined and plans were undertaken to obtain the necessary data by interviewing 300 employees upon their return to work following vacation.

The Interviews

IN THE collection of data, the first step was the preparation of the basic interview form (see Fig. 1). This questionnaire was filled out by the interviewer at the time the employee was seen, and the actual responses were recorded. In the course of the interview, or immediately following it, the answers were delegated to the various categories shown on the questionnaire in preparation for the statistical analysis. In the most part the interviews were conducted within two weeks of the individual's return to work. The information was collected throughout the year 1949, with one vacation only studied for an individual, although he may have had two separate one-week vacations during the year. Reactions on the part of employees to the request for an interview were varied. Some came in with the attitude, "what's in this for me"; others were very eager to be helpful, even to the point of giving extraneous details; still others pointed out that they already knew what type of vacation was best from a health standpoint. This last information proved non-contributory, however, since comments ranged from "you should stay home and take it easy" to "you should get away somewhere to completely new surroundings and enjoy yourself."

Admittedly, some of the data collected are highly subjective in nature and can be pre-

(Sex, age, marital status and race written in here)
CONFIDENTIAL

NAME ..... BADGE..... OCCUPATION .....
VACATION: Duration.....weeks; Dated started (first work day) .....
OCCUPATION: Indoors or Outdoors? Physical exertion—Yes, No.
Problems to work out in connection with job—Few, Some, Many.
Under a tension on the job most of the time—Yes, No.
Do you feel different after your vacation?—Yes, No. How?—Better, Worse.
How do you feel about returning to work?—Eager, Neutral, Reluctant.
What do you think of as an ideal vacation? All time at once, Split.
Months preferred:
DESCRIPTION OF VACATION: (where, how long, type of accommodations, time spent traveling)
ACTIVITIES: (what did, approximate amount of time devoted to it)
Relaxation Recreation Exercise Productive Job Related
Which of the above activities had you done infrequently or not at all in the six months preceding your vacation? (Check above)
Usual average length of sleep per night.....hrs.; On vacation.....hrs.
Normal meals (quantity, variety, regularity, source)
Usual amount of exercise in non-working hours—Little, Some, A lot
More exercise on vacation?—Yes, No. Which did you enjoy more?
Felt relaxed—Before vacation, On vacation, After vacation.
Were there any particularly upsetting events during your vacation, financial worries, illnesses (self or family)?
Is your present health the same or different compared to your health before vacation?
What was your previous state of health?—Good, Average, Poor.
(If changed) Is your present state of health better or worse?
What do you think brought the change about?

Fig. 1.
Basic Interview Form

sented only as an aggregate of individual opinions. One person's evaluation of improvement in health might not be the same as that of another. Also, certain questions, such as how the person felt about returning to work, may not have been answered truthfully in some cases. However, by making an effort to conduct each interview on a personal, confidential basis, and by having one person evaluate all the responses, it is felt that the basic data are as reliable as can be gathered for this type of study.

When the interviews were completed, the findings were summarized and statistical procedures consisting of X^2 significance tests (.95 certainty level) were performed to determine the relationships of the various factors.

The Findings

THE study was designed to have the sample of 300 people be typical of the entire Laboratory in regard to sex with 20.0% females (60), race with 10.0% colored (30), and occupation with one-third professional or semi-professional, skilled workers and clerical personnel each about three-tenths, and one-tenth unskilled laborers. The age distribution had approximately one-third in the twenties and one-third in the thirties, with the balance 40 and older; and marital status was divided into 239, or 79.7%, married and 61, or 20.3%, single, approximating conditions at the Laboratory.

TABLE 1.
DURATION OF VACATION FOR 300 EMPLOYEES

Duration	Number	Per Cent
One Week	138	46.0
Two Weeks	162	54.0
Total	300	

Although the vacation choice of shift workers may have enabled them to have about 10 days off from work by combining a week's vacation and regular scheduled time off, and the occurrence of holidays or illness before or after the vacation may have extended the vacation time period somewhat, the durations of vacations shown in Table 1 are based on the amount of actual paid vacation. A vacation one week in length meant different things to different people as evidenced by the comments of two vacationists: "it was no different from a week-end," and "I felt as though I had been away a long time."

The time of year in which those questioned had their vacations, presented in Table 2, is not typical of the Laboratory necessarily, although, owing to the employee's becoming eligible for his vacation six months or a year after employment (within the first two years of employment), vacations are likely to be taken at any time of the year. Contrary to the generally accepted belief that most people prefer vacations in the summer, it was found in this study that, of those who expressed a definite preference regarding time of year for vacation, 43.7% preferred the summer, while 49.4% preferred spring or fall

TABLE 2.
TIME OF YEAR OF VACATION STUDIED FOR 300 EMPLOYEES

Time of Year	Number	Per cent
January-February	1	0.3
March-April	0	0
May-June	49	16.3
July-August	99	33.0
September-October	134	44.7
November-December	17	5.7
Total	300	

TABLE 3.
TYPE OF VACATION FOR 300 EMPLOYEES

Type of Vacation	Number	Per cent
Trip to pleasure destination, as a resort	54	18.0
Relative visiting trip	87	29.0
Continuous trip	19	6.3
At home with short trip or trips	71	23.7
Local resort	9	3.0
At home vacationing	38	12.7
At home working	22	7.3
Total	300	

or both, and 6.9% selected the winter months as their choice. The summer vacation proved to be a controversial issue. Many took vacations in the summer months because of their children but did not actually prefer them. The summer heat was given both as a good reason to be away from work on vacation and a factor to be avoided because it would spoil the vacation.

In Table 3 the types of vacations included in the survey are shown. The highest percentage given, for trips to visit relatives, is not assumed to be a finding which would be generally typical in industry. However, the type of personnel at the Laboratory, for the most part young people recruited from all over the country, leads one to expect that many would visit their parents' homes. As would be anticipated, the type of vacation was related to income, and somewhat dependent on age, there being more people in the twenties who took trips to visit relatives, and more people in the forties who stayed at their homes undertaking various forms of productive enterprise.

The major vacation activities of the study group, as shown in Table 4, included up to three main types of activity per person. In a few cases, the individual had some activity in each of the general activity groups, or possibly in all but one of them, so a separate category was made for these people. Many stressed that their main desire concerning their vacation activities was to do whatever appealed to them at the time, without regard to routine or planning. In connection with activities, it should be mentioned that the following events more or less dominated the vacations of the people concerned: illness in the family (9), personal illness during vacation (5), moving (4), building a house (2), personal illness before vacation (2), death in the family (2), marriage (2), and birth in the family (2).

TABLE 4.
VACATION ACTIVITIES FOR 300 EMPLOYEES

Activity	Number of People	Per cent of 300 People
Variety of activities	20	6.7
Relaxation, "taking it easy"	80	26.7
Recreation, pursuit of hobbies	120	40.0
Sports, out-of-door activity	154	51.3
Social, visiting, enjoying family life	149	49.7
Travel, sightseeing*	87	29.0
Productive activity	111	37.0

*Trips purely to reach a destination are not included here as an activity.

WITH the information given thus far about the people studied and the vacations they had, the stage is set for an examination of special characteristics of the people or their vacations in relation to the results produced by the vacation. The various measures of success of the vacation from a health aspect were: an improvement in the person's feeling of well-being; a change in his general state of health; and a satisfactory attitude about returning to work.

The estimate of the degree of improvement in feeling of well-being was based on a person's response to the query on how he felt after his vacation. For people who did notice a difference, the most general response was that they felt more rested or more relaxed. Some of the more unusual answers included: "I seem to be more tired now than when I left"; "my spirits are higher"; "I have more pep and an improved disposition." One person commented, "This is the first time I've really felt rested after a vacation." Some felt relaxed for one or two days only following their vacations.

Based on responses to the inquiry about an individual's health before and after vacation, an estimate of improved health was formed. One gratifying response was, "I'm in better shape than I've been in 10 years." People gave credit for improvement in their health to: more exercise, sunshine and fresh air, changes in surroundings, relief from strain and responsibility, medical attention, rest, and the eating of regular meals.

The attitude which people had about returning to work ranged from a flat, "I did not want to come back" to "couldn't wait to get back to see what happened while I was gone."

Before determining the effect of various vacation factors on these ratings, (hereafter called improved health measures), the relations exist-

TABLE 5.
RELATION BETWEEN FEELING OF WELL-BEING FOLLOWING VACATION AND TENSION EXPERIENCED ON VACATION

Feeling of Well-being	Tension on Vacation							
	None		Some		Definite Tension		Total	
	Number	Per cent	Number	Per cent	Number	Per cent	Nmber	Percent
Increased	151	62.4	26	54.2	4	40.0	181	60.3
Same	82	33.9	11	22.9	4	40.0	97	32.3
Decreased	9	3.7	11	22.9	2	20.0	22	7.3
Total	242		48		10		300	

Significant Relationship

TABLE 6.
RELATION BETWEEN FEELING OF WELL-BEING FOLLOWING VACATION AND MORE SLEEP THAN USUAL

Feeling of Well-being	Vacation Sleep: Same or Less		Vacation Sleep: More		Total	
	No.	Per cent	No.	Per cent	No.	Per cent
Increased	73	52.9	108	66.7	181	60.3
Same	52	37.7	45	27.8	97	32.3
Decreased	13	9.4	9	5.5	22	7.3
Total	138		162		300	

Significant Relationship

ing between permanent characteristics of the individual and the improved health measures had to be ascertained, irrespective of what he did on vacation. Significant differences in responses indicate that one can say, with the probability of making a true statement 95 times out of 100, that a person's attitude about returning to work after a vacation is related to the following characteristics: sex, nutritional state (based on quantity of food eaten, variety of foods and regularity of meals), and ordinary health rating. This last was an evaluation of normal health factors, based on health status, adequate sleep, adequate nutrition, adequate exercise, and freedom from nervous tension under ordinary conditions, which almost without exception demonstrated increased eagerness to return to work in connection with a progressively higher health rating. Age yielded one significant finding, namely, a smaller proportion of those in their twenties was eager to return, whereas a larger proportion was reluctant about returning. These personal characteristics were related only to attitude about returning to work.

Other characteristics tested, but not demonstrating any significant relations to the improved health measures were: marital status, race, occupation, degree of mental work on the job, tension on the job, normal amount of sleep, and normal amount of exercise. It is concluded, then, that regardless of vacation conditions, relatively more of the women, the employees in their twenties, those with inadequate nutrition, and those whose normal lives do not meet accepted standards of health-inducing conditions, will be reluctant to return to work. All of these facts could be attributed to a person's attitude toward his job if it is assumed that these special groups might, in general, have less eagerness in the pursuit of their vocations.

TABLE 8.
RELATION BETWEEN FEELING OF WELL-BEING FOLLOWING VACATION AND DURATION OF VACATION

Feeling of Well-being	Duration: One Week		Duration: Two Weeks		Total	
	No.	Per cent	No.	Per cent	No.	Per cent
Increased	74	53.6*	107	66.0*	181	60.3
Same	54	39.1†	43	26.5†	97	32.3
Decreased	10	7.2	12	7.4	22	7.3
Total	138		162		300	

Not Significantly Related
*Significant Difference
†Significant Difference

TABLE 7.
RELATION BETWEEN HEALTH STATUS AFTER VACATION AND OUT-OF-THE-ORDINARY ACTIVITIES ON VACATION

Health Status	Some Out-of-the-ordinary Activities: Yes		Some Out-of-the-ordinary Activities: No		Total	
	No.	Per cent	No.	Per cent	No.	Per cent
Improved	29	18.5	10	7.0	39	13.0
Same	127	80.9	131	91.6	258	86.0
Worse	1	0.6	2	1.4	3	1.0
Total	157		143		300	

Significant Relationship

The relations between various characteristics of the vacation and the same three measures of vacation effects, a feeling of increased well-being, improved health, and attitude toward return to work, then were investigated.

Testing the degree of tension experienced on vacation and the feeling of well-being after vacation, as shown in Table 5, those who experienced no tension in the course of their vacations demonstrated the most improvement resulting from the vacation and the least decrease in their feeling of well-being.

In Table 6 it is shown that those who slept longer than usual while on vacation had an increase in feeling of well-being following the vacation, while those who had their accustomed amount of sleep or less, had a greater representation among those whose feeling of well-being was decreased.

The general opinion about vacation activities is that doing something different from the normal year-round activities is beneficial. This attitude was validated by the findings in Table 7 regarding health status following vacation and out-of-the-ordinary vacation activities. Those with this type of activity showed a higher proportion with improved post-vacation health, whereas those who did nothing different during the vacation, had a lower proportion with improved health.

The relationships between the improved health measures and various characteristics of the vacation presented in Tables 5, 6 and 7 established that the two factors studied in each case were not independent. Other findings did not lead to this same conclusion, but nevertheless established certain relationships. Table 8 shows findings regarding duration of vacation and the feeling of well-being following vacation, wherein those with two weeks' vacation showed more of an increase in feeling of well-being than those with a single week of vacation.

It is demonstrated in Table 9, concerning the amount of vacation travel and the feeling of well-being following vacation, that those who did considerable driving experienced less improvement and more reduction in feeling of well-being than all other classifications combined. As one person expressed it, "A vacation with driving is probably more exhausting than work."

When the type of vacation was tested with the health status following vacation, as shown in Table 10, the only positive finding related to

TABLE 9.
RELATION BETWEEN FEELING OF WELL-BEING FOLLOWING VACATION AND AMOUNT OF VACATION TRAVEL

Feeling of Well-being	Vacation Travel: Considerable Driving		Considerable Riding		Small Amount of Either		Practically None of Either		Total	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Increased	54	50.5*	23	74.2	38	65.5	66	63.5	181	60.3
Same	38	35.5*	7	22.6	18	31.0	34	32.7	97	32.3
Decreased	15	14.0†	1	3.2†	2	3.4†	4	3.8†	22	7.3
Total	107		31		58		104		300	

Not Significantly Related
*Significant difference comparing the breakdown marked to all other breakdowns.
†Significant difference comparing the breakdown marked to all other breakdowns.

those who spent the vacation at local resorts. These noted a distinct improvement in health, whereas people taking other types of vacations showed less improvement.

In Table 11 the type of vacation was studied in relation to the attitude about returning to work. Here, those who took a long trip to a pleasure destination, such as a resort, were less eager to return to their jobs than those taking other types of vacations. Typical of the sentiment of this group was the remark, "I was just beginning to enjoy myself when I had to come back."

The vacation characteristics shown in Tables 5 through 11, degree of tension, more sleep than usual, out-of-the-ordinary activities, duration of vacation, amount of travel and type of vacation, were related only to the improved health measures shown for them. Other vacation measures tested for their effect in giving vacation health benefits were exercise, type of activity, out-of-door activity and vacation health rating (based on vacation conditions believed to contribute to health in general). These, however, did not lead to any significant findings. Showing no clearly defined trend were the findings for time of year and feeling of well-being, wherein those vacationing in July and August had a higher proportion with an increased feeling of well-being and also a higher proportion with decreased feeling of well-being. The same type of findings was demonstrated for time of year and attitude about return to work, showing that those vacationing in September and October had a greater proportion eager to return to work and also a greater proportion reluctant to return.

One other type of vacation characteristic was tested with the improved health measures. The study group was examined by the degree of fulfillment of desires regarding duration of vacation, time of year for vacation, and type of activities while on vacation, but there were no significant findings. Needless to say, the desires which were expressed for an ideal vacation covered a wide range, including such opposites as, "get away from the family," "have time to enjoy being with the family," "stay at home and lie around," and "do something, no matter what, but not just stay home and sit."

The feeling of well-being following vacation was increased for those who had no vacation tension, who slept more than usual, who had a two-weeks' vacation rather than one-week's, and decreased for those who did considerable driving. Improved health resulted for a higher proportion of those with vacation activities different from their ordinary activities, and for a higher proportion of those vacationing at a local resort. More reluctance at returning to work was demonstrated for those taking a long trip to a pleasure destination. Therefore, it can be stated definitely that certain aspects of the vacation do promote improved health for the employee.

Two pithy employee comments fittingly conclude the study, the observation, "I enjoyed my vacation more than anything else since I've been working here," and the advice, "Don't spend more than you can afford, and don't drive yourself physically as I did."

Summary

THE granting of vacations to industrial workers is based on the belief that the vacation improves the health and efficiency of the worker.

TABLE 10.
RELATION BETWEEN HEALTH STATUS AFTER VACATION AND TYPE OF VACATION

Health Status	Type of Vacation: Resort Trip		Relative Visiting Trip		Continuous Trip		Home With Short Trips		Local Resort		Home Vacationing		Home Working		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Improved	9	16.7	12	13.9	1	5.2	7	9.9	5	55.6*	3	7.9	2	9.1	39	13.0
Same	43	79.6	74	85.0	18	94.7	64	90.1	4	44.4*	35	92.1	20	90.9	258	86.0
Worse	2	3.7	1	1.1	0	0	0	0	0	0	0	0	0	0	3	1.0
Total	54		87		19		71		9		38		22		300	

Not Significantly Related
*Significant difference comparing the breakdown marked to all other breakdowns.

TABLE 11.
RELATION BETWEEN ATTITUDE ABOUT RETURN TO WORK AND TYPE OF VACATION

Attitude About Return	Type of Vacation: Resort Trip No.	%	Relative Visiting Trip No.	%	Continuous Trip No.	%	Home With Short Trips No.	%	Local Resort No.	%	Home Vacationing No.	%	Home Working No.	%	Total No.	%
Eager	12	22.2*	28	32.2	9	47.4	27	38.0	1	11.1	20	52.6	8	36.4	105	35.0
Neutral	30	55.6*	53	60.9	7	36.8	39	54.9	8	88.9	14	36.8	12	54.5	163	54.3
Reluctant	12	22.2*	6	6.9	3	15.8	5	7.0	0	0	4	10.5	2	9.1	32	10.7
Total	54		87		19		71		9		38		22		300	

Not Significantly Related
*Significant difference comparing the breakdown marked to all other breakdowns.

2. To study the actual effect of vacations in health and morale improvement, a survey was outlined based on post-vacation interviews with 300 employees of the Oak Ridge National Laboratory.

3. The characteristics of the sample population regarding sex, age, marital status, race, and occupation, approximating those of the Laboratory as a whole, were presented, in addition to the duration, the time of year, the types of vacations taken, and the major vacation activities indulged in.

4. As the standards for measuring the success of the vacation from a health standpoint, improved feeling of well-being, improved health, and the return to work attitude were chosen.

5. It was noted that the attitude toward returning to work was related to sex, age, nutrition and health factors, regardless of vacation conditions.

6. Relationships were established between the degree of the feeling of well-being following the vacation and the amount of vacation tension, between the feeling of well-being and the amount of sleep obtained during the vacation, and between improvement in the health status following vacation and the pursuit of activities different from the ordinary routine.

7. In general, the type of vacation, the specific kinds of activities, the amount of exercise or out-of-door activity, the time of year of the vacation, and the degree to which desires for an ideal vacation were fulfilled, had little effect on the success of the vacation from a health viewpoint.

8. The maximal health benefit was derived from a vacation that was free from tension, including excessive driving, that permitted more sleep than usual, that included activities different from daily routine, and that was two weeks in duration, rather than one week.

Conclusions

THE empirical knowledge which has led to the establishment of paid vacations, with the motivation of improving employee health, is established as scientifically valid.

2. The trend toward universal acceptance of the principle of vacations with remuneration for all workers has accelerated rapidly in the past few years, but there is still a need for progress in this direction.

3. For the derivation of maximal health benefits, a vacation consisting of two consecutive weeks, in contrast to one week at a time, has a distinct advantage.

4. Vacations should be planned to take advantage of the factors most likely to induce positive health.

5. Identified in such a study are special groups having an unsatisfactory attitude, not ameliorated by vacation, toward their work, for whom investigation and reorientation should prove beneficial.

[GRATEFUL acknowledgment is extended to DR. JEAN S. FELTON, Medical Director of the Oak Ridge National Laboratory, under whose guidance this study was planned and executed, to MISS DORIS B. SCOTT for some of the basic interviews, and to DR. ALSTON S. HOUSEHOLDER for suggestions as to statistical procedure.]

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Skin Hazards in the Fur Industry

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CLOSELY allied to the leather industry, the dermatological hazards of which have been previously reviewed,[1,2] is the fur industry. This relationship is understandable since both industries begin with similar raw materials and have similar operations during the early steps of the manufacture. The relationship of these industries is also expressed by the employees who are organized in one trade union (International Fur & Leather Workers Union, C.I.O.). However, in the transformation of a skin or hide to leather (process of tanning) little consideration is given to the hair, which becomes a by-product; in the transformation of a skin for the fur trade (process of dressing) the hair is of prime importance.

The purpose of this survey is to describe the working environment of the fur industry in the Philadelphia center, the dermatological problems encountered, and the agents responsible for these dermatological conditions. It follows the course of previous investigations: supervised tours through several plants; examinations of the employees at their jobs; and the review of private office records (M.H.S.) and statistical data supplied by the Department of Labor and Industry of the Commonwealth of Pennsylvania.*

Three distinct and separate operations are required to convert a skin from the time it leaves the animal's back until it becomes a saleable commodity. The first process is the removal from the animal's body. Excess fat is then scraped off the green hide in order to insure rapid and proper drying. Drying is accomplished by pulling the wet fresh skin upon shaped wire or wooden stretchers which are left in a cool, dry place, or indoors in a cool room. From this raw stage the peltry is now prepared for the second operation: the dressing and dyeing stage. The third process is the manufacture of finished garments. Only the dressing and dyeing process and the manufacture of fur garments were investigated in this study. A description of these processes and the skin hazards involved follows.

Nearly 100 different types of skins are used in the fur trade. They are from wild, friendly, or domestic animals, and are processed in two different classes of dressing plants: those that handle skins from sheep, goats, and other herbivorous animals, and those that handle skins of carnivorous animals. In the dressing plants inspected, the skins of lambs are treated to make the so-called "mouton-processed lamb" and the dressing and dyeing processes to be described are specific for the moutons. Similar operations with some modifications are encountered in the treatment of other types of skins, but the hazards productive of skin eruptions on the worker are essentially the same.

In the Philadelphia Industrial Center there are approximately 210 employed in the fur dressing and dyeing industry. Of this group, 20% are women and 30% are negroes. The fur manufacturing branch employs 260 workers, of whom 7.5% are women and 1.6% negroes. All workers in the fur manufacturing industries are classified as skilled and receive the highest pay scale of any industrial workers in the United States.

The Fur Dressing and Dyeing Industry

TWO large fur dressing and dyeing plants were surveyed. One plant processes 8000 furs per week and the other about 2000 furs. The greater percentage of the furs were domestic. With furs that are imported, previous inspection at the port by the Bureau of Animal Industry is mandatory before they can be received at the factories.

The skins, which are delivered to the factories in boxcars, are in the salted state and are greasy and dirty. The hides are removed manually and, immediately after unloading, the boxcars are sprayed with a disinfectant solution. The hides are then graded and trimmed. It is in these two initial operations that the worker is subject to contact with anthrax. A sack apron is the only protective garment worn by the men who unload, grade and trim the hides. In the two plants inspected, however, not a single case of anthrax had been reported in the past 10 years.

The hides are then moved to the "beam house." Here the furs are scoured with a highly alkaline solution of soap and soda ash. The floor of the beam house is made of concrete and fitted with many drains, permitting it to be kept clean and as dry as possible. All workers in this department are supplied with protective garments consisting of rubber aprons, gloves and hip boots. It is during this process that the salt and grease are removed. There were no instances of dermatitis observed in these workers.

From the Department of Dermatology, Service of DR. M. H. SAMITZ, Graduate Hospital, University of Pennsylvania.

*Courtesy of WILLIAM H. CHESTNUT, Secretary of the Department of Labor and Industry.

Fleshing is the next operation. This is either manual or mechanical, carried out by exceptionally skilled workers. The purpose is to remove the undesirable fat. In one plant, this is done as the flesher pulls the skin evenly toward him across the razor-shaped fleshing knife. A majority of the fur fleshers could be identified by their disfigured finger nails. The mechanism responsible for the onycholysis has been reported by Hemann and Silverberg.[3] Although this occupational stigma was disfiguring, it was not disabling. No satisfactory guards to protect the nails of the fur flesher have as yet been devised. In the other plant, this operation was mechanical and onycholysis was not seen.

The skins are now ready to be converted into the dressed state. The hides previously alkalinized by the scouring process are neutralized by pickling in a solution of sulfuric acid and salt. The pH of this solution is 3. This process is completely enclosed, thus presenting no dermatological hazards.

The next stage of dressing requires the skins to be immersed in a tanning fluid. In the plants inspected, the skins are placed in drums containing solutions of chromic acid and alum. The time required for this operation is variable but as a rule the skins remained in the drums overnight. The occurrence of chrome bites is always possible among the tanners. The furs are then taken to the putting-out pachine where they move between two rollers so that the excess fluid and waste are removed. The drying is completed by hanging in a drying room where a temperature of 100 to 140° F is maintained.

Staking is the next process. This is a mechanical operation which softens the fur and permits stretching. The workers here are known as stakers and can be identified by their knuckle pads—callosities over the phalangeal joints produced by friction and pressure in carrying out the staking operation.

The next operation is known as buffing. This is a mechanical process in which the flesh side of the fur is brushed until it is smooth and uniform. The furs are then toggled, a process in which they are stretched over a fine mesh screen and held in place by toggles. The operators, togglers, can be identified by the presence of callosities on the hypothenar and flexor aspects of the fingers. To prevent these disfiguring stigmata and subsequent irritation, many of the togglers protect their fingers with adhesive strippings or leather finger cots. A small number also showed calluses of the knuckles.

A plasticide made of a formaldehyde derivative (formula: trade secret) is then painted on the flesh side of the fur, which is then subjected to the hot machine, a process in which the furs are electrified by static electricity. This treatment is repeated a number of times in order to produce the desired result. After the hot machine operation, the furs are combed and sheared. This removes the excess wool, and the fur is cut until it is of uniform height. The painting of the plasticide is done in a special room which is equipped with a ventilating system so that concentration of the formaldehyde in the room is minimized. All the workers in this department wear rubber gloves and aprons. Despite these precautionary measures, approximately 0.5% of the working personnel developed pruritic erythematous eruptions of the hands, forearms and crural regions. Younger workers were more apt to develop these than the older ones who had learned from experience the necessity of wearing gloves and leather aprons. The sites most frequently involved were the genital and crural regions. The predilection for these areas is explained by two factors: that the upper portion of the worker's trousers would come in direct contact with the plasticized fur, and that the skin of these areas is extremely thin, thereby predisposing to irritation and sensitization. Some of the workers became hardened and were able to continue at their jobs; those who persisted in their dermatitis had to be shifted to other departments or left the industry.

If the furs are to be dyed, only intermediate dyes are used. The classes of dyes and the methods of dyeing for different types of furs have been reviewed by Schwartz, Tulipan, and Peck.[4] Sensitization to any of these dyes is the dermatological hazard. In the plants surveyed, the incidence of sensitization was very low, but no records were available for the compilation of statistics.

Bleaching, the removal of color in order to produce desired pale or whitish hair, was not observed in these plants. The reducing and oxidizing agents used in this process are chemicals which have potential sensitizing or primary irritant capacities. These hazards are not reviewed in this study, for these agents were not used in the factories surveyed.

The final operation is that of dry cleaning. This is an enclosed process in which various solvents are used.

No cases of dermatitis were observed among the workers in this department.

A RESUME of the agents responsible and the dermatological conditions observed among fur dressers and dyers is:

1. Mechanical agents: friction and pressure producing occupational stigmata as:
   (a) Onycholysis—among the fleshers.
   (b) Knuckle pad calluses—stakers.
   (c) Calluses—hypothenar and flexor aspects of fingers—togglers.
2. Biochemical agents: bacterial—anthrax—handlers of the raw furs.
3. Chemical agents:
   (a) Inorganic: chromic acid—chrome ulcers—the tanning department.
   (b) Organic: eczematous eruptions due to sensitization:
      (1) Dyes—dye house workers.
      (2) Formaldehyde — plasticizing department.

The Fur Manufacturing Industry

FUR COAT manufacturing concerns are divided into two groups: those that make the finer garments and are known as style houses, and the quantity houses where the production system is used to turn out "ready-made" garments.

In the Philadelphia Industrial area there are 61 retail fur manufacturing shops. These are small establishments, employing on an average of four to six employees. Only the finished furs are used by the manufacturer.

The first operation is carried out by the floor boy whose job is to wet the flesh side of the fur. This allows for the stretching. The cutter then assembles the furs and matches them according to color, shade, luster, and height. He then cuts them into the desired patterns. The cut furs are sewed together by the operator, and are nailed to a wooden board, flesh side up, stretched to the designs of the patterns, and moistened with water. This operation is performed by the nailer. After drying overnight the furs are again squared off to the pattern replica. The finisher then completes the sewing: a lining is placed into the garment, shoulder pads are sewed in place, and all unfinished sewing is done. This results in the finished garment.

Common to these workers were the skin stigmata of the trade, trauma being the causative agent.

The following dermatological conditions were observed:

(1) Cutter—cuts and pin pricks.

(2) Operator—fissuring of the index finger and thumb.

(3) Nailer—pin pricks of palmer aspects of finger tip.

(4) Finishers—thickening and fissuring of finger tips: the seamstress fingers.

Occasionally an eczematous dermatitis due to sensitization by the dye in Persian furs was seen. Sensitization to natural fur, as, for example, mink, beaver, and muskrat, was not reported.

Several patients referred to one of us (M.H.S.) with eruptions supposedly due to exposure to furs were found to have dermatological entities of non-occupational origin. Two of these patients (an operator and a finisher) presented problems of localized palmar psoriasis, a classical picture recently described by Caro and Senear.[5] It was hypothecated that the recalcitrant nature and probably even a contributory factor in the causation of this form of psoriasis were due to the Koebner phenomenon provoked in the sewing and cutting operations. A third patient with a pruritic scaly and erythematous eruption of the face, neck and forearms, who had been previously treated for "fur eczema," was found to have an eczematous contact-type dermatitis (the contactant was a proprietary ointment applied) superimposed on seborrheic habitus. After the eczematous dermatitis cleared, subsequent patch tests with natural and dyed furs used by the employee were negative, and his return to his job as a cutter resulted in no recurrence.

Conclusions

TRAUMA is the most common factor in the production of dermatological problems in the fur industry.

2. Instances of epidermal sensitization to natural and dyed fur are infrequent.

3. Sensitivity to formaldehyde is a definite hazard in the mouton-processing plants.

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"We Were All Taken In"

ONE HEARS a lot these days about the benefits of a "mixed" economy, about the merits in combining free enterprise and government controls. Whenever I hear about them, I think of the sad story of my native Czechoslovakia, where I was Chief of the Economic Department in the Ministry of Finance from the end of the war until last April. We Czechs were all taken in by the notion that nationalization and private enterprise could work harmoniously together. British and American journalists, confirming our hopes, sent back glowing accounts of the new "experiment." Czechoslovakia, we told ourselves jubilantly, would show the world how to combine the advantages of capitalism with those of a controlled economy. She did nothing of the sort. Her soft socialism froze into hard, dogmatic totalitarianism as naturally as a lake freezes in winter .... But even though it was a special case in this and other ways, my country provides a spectacular if poignant illustration of how soft socialism ends in freezing.

—From "Planning for Destruction," by HUGO SKALA, in *Fortune*, August, 1949.

An Antihistaminic Analgesic Preparation in the Therapy of Colds
—Final Report—

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IN A PREVIOUS report[1] it was demonstrated that treatment with a compound antihistaminic analgesic preparation was effective in reducing the average duration of colds more than 50% as compared with the effects of aspirin. This antihistaminic preparation contained an antihistaminic drug, chlorothen citrate* 25 mg., acetophenetidin 320 mg. and caffeine 32 mg. The method of procedure was fully described in this preliminary report. The employees of an industrial plant** were divided into two groups: those whose names began with the letters "A" to "K" were given the compound, while the remainder were given aspirin in an identically appearing tablet. The employees were instructed to report to the physician's office at the first sign of a cold and to report daily thereafter. If they remained at home during treatment they were instructed to report to the physician's office on their return to work. Daily observations were possible in 99% of the employees.

DOSAGE: Each person treated received one tablet of the compound orally on reporting to the physician's office and one tablet every three hours thereafter. Treatment was continued for a minimum of 48 hours. Employees who were given aspirin followed the same schedule.

RESULTS: The tabulation shows the results obtained. The average duration of the colds in those taking the compound was 2.3 days, and in those taking the aspirin six days. The employees, however, did not remain under observation longer than seven days. It is of interest to note that of the employees receiving aspirin, 38 out of a total of 120, or more than 30%, received no improvement whatsoever from the use of the aspirin. In all persons using the compound there was some degree of improvement. Of 97 to whom the compound was administered within 24 hours of the onset of the symptoms, 67, or 69%, showed the symptoms gone within three days and 25% within one day. Of 91 who received aspirin on the first day of the onset, 46, or 52%, reported relief within three days, but only 15% within the first day.

In the therapy of colds it is not only important to shorten the duration but also to attain symptomatic relief while the cold persists. From this standpoint, the compound was much more effective than aspirin. The great majority of persons under treatment reported prompt symptomatic relief. They felt better and were able to continue working. In only one case was it necessary for the individual to remain at home when the compound was used, while with those under treatment with aspirin a stay at home of one or more days was necessary in 15 instances.

REACTIONS: With the compound the following reactions were noted: lightheadedness (1), nausea (5), warmth and perspiration (6), sleepiness (10), dizziness (1), flushing (1). These reactions were sufficiently severe in only one case to make discontinuance of the medication necessary.

With the aspirin the following reactions occurred: excessive sweating (2), sleepiness (7), nausea (3), dizziness (2), "burning" in abdomen (2), vomiting (2), pain in abdomen (2), bloating (1). In four instances the reactions were of sufficient severity to cause the person to stop medication.

Comment

THE VALUE of antihistaminic agents in the therapy of the common cold depends on the fact that a like substance is present in the nasal secretions of patients afflicted with colds as demonstrated by Troescher-Elam, Ancona and Kerr[2]. Previous studies have shown the efficacy of various antihistaminics in the treatment of the common cold.[3,4,5] Varying degrees of toxicity have been reported, depending on the antihistaminic agent employed and the dosage. It would appear, in general, that the greater the effectiveness in curtailing cold symptoms the more likelihood there is of some degree of toxicity. With Caubren Compound, however, although symptomatic relief and shortening of the duration of colds were attained, toxic reactions occurred infrequently and were only of minor importance. Of 135 persons receiving treatment reactions occurred in only about 10%. It is of interest to note that of 120 persons receiving only aspirin

Caubren® Compound, Whittier Laboratories, Division Nutrition Research Laboratories, Chicago.

*N, N-Dimethyl—(2-pyridyl)-N-(5-chloro-2-thenyl)—ethylenediamine citrate.

**Bastian-Blessing Company, 4201 West Peterson Avenue, Chicago.

	CAUBREN COMPOUND: Day of Administration after onset of symptoms		
Duration of Colds	1 day	2 days	More than 2 days
1 day	25		
2 days	23	3	2
3 days	19	2	5
More than 3 days	30	8	18
Total	97	13	25

	ASPIRIN: Day of Administration after onset of symptoms		
Duration of Colds	1 day	2 days	More than 2 days
1 day	14		
2 days	19	2	
3 days	13	1	1
More than 3 days	20	4	8
No improvement	25	8	5
Total	91	15	14

17% had reactions which in many instances were more severe than those noted with the compound.

Conclusions

CAUBREN Compound is an effective agent in relieving the symptoms of colds, in shortening the duration and aborting the infection when administered early. If administered within two to five days after cold symptoms appear the duration is shortened and the symptoms abated.

2. This compound is noticeably outstanding in the infrequency of reactions which occur with its use, less than acetylsalicylic acid and of less severity.

3. The analgesic and antipyretic drugs combined with the antihistaminic agent serve to aid in relieving cold symptoms. Caffeine, by its stimulant action, counteracts the sedative effect some individuals experience with antihistaminic preparations, which accounts for the decreased frequency of sleepiness as a reaction when this preparation is employed.

4. Because of its comparative safety, effectiveness and prompt action this compound may be recommended in aborting and treating the common cold.

Citations

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Short Scientific Papers

YOUR editors have occasionally harped upon the subject of suitable material for publication in the Journal. A principal theme has been the need for shortening papers. The problem is becoming more acute with soaring costs of printing, more societies and members to serve, and plenty of good scientific material worthy of printing. An excellent article on the subject of good medical writing has just appeared in the *Staff Meetings of the Mayo Clinic*, by Dr. Walter C. Alvarez. His experience is well known and he speaks authoritatively. His ideas have inspired us to renew our editorial comment upon medical writing. The articles which are read, talked about, and which are of most educational value are the ones which are short and interesting. Many readers glance first at the summary and conclusion. If these have a "punch," they return to the beginning to sort out the meat. Few papers are injured by being abridged. Most useful messages can be practically conveyed within 10 minutes' reading time. Our good writers rarely are the ones who write easily; they are rather the authors who apply themselves laboriously, set the work aside, sleep on it, returning after a few weeks to see if they still feel the same way about it. The material is then reviewed, modified, changed and—fortunately—shortened. When the author asks himself whether his message fills a gap in the world's knowledge or whether it settles a controversy, he may decide that it does not. If such is the case, the wastebasket should receive another contribution. The article should start in such a manner as to incite interest, which is maintained through the absence of uninteresting material. Historical comment, inconclusive statistics, and minor technical details are the first to dispel reader interest. Dr. Alvarez agrees with our convictions that few bibliographies should be published, especially the large ones. Some authors are disappointed if readers are not impressed by innumerable articles the author seems to have studied. In case reports, there is no need for patients' initials, hospital number, exact date of admission, or irrelevant family or personal history. Likewise findings at operation or at autopsy should be positive findings only. Voluminous case reports do not impress readers with an author's thoroughness but rather that the author is inefficient and that his brain is muddled. Work your material over several times; cut out all irrelevant and negative data; shorten your sentences; delete most adjectives and all superfluous words. Speak in plain English and use the shortest generally accepted spelling. Impress your readers with your clear thinking, practical interpretation of your problem, efficient management, and sensible approach—not your erudite background and worldly perspective. Your summary should state more than that such and such has been reviewed, or this and that conclusion drawn. It should be a true, but brief and pointed, abridgement of the paper for the benefit of readers who read no more and to show students what they may expect to find in somewhat more detail in the body of the article.

—*Rocky Mountain Med. J.*, October, 1949; reprinted in *Pennsylvania Med. J.*, December, 1949.

AMERICAN ASSOCIATION OF RAILWAY SURGEONS

PRESIDENT'S PAGE

AS PRESIDENT of the AMERICAN ASSOCIATION OF RAILWAY SURGEONS, I should like to send greetings to each of our members, as well as to all physicians who are active in railway medicine and surgery.

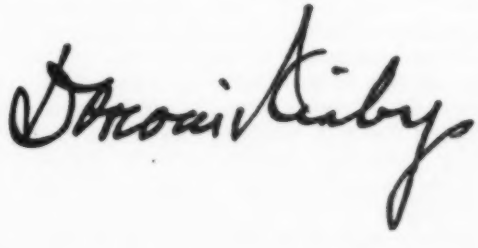
The part played by the physicians of the United States in the protection and care of industrial workers is well known, and the importance of their work has become so thoroughly established that now industrial medicine and surgery constitute a recognized specialty. The Railway Surgeons have had a long and honorable part in the development of this specialty. Their organization, the AMERICAN ASSOCIATION OF RAILWAY SURGEONS, was founded in 1888; since then their Annual Meetings, held without interruption except for the four years of World War II, have been among the important events of the successive years.

A directory of the members of the Association is now being published. In it there will be a list of the past officers of the Association, among whom one will find the names of many of the most illustrious surgeons of the United States of the last 60 years. More than 120 railroads are now represented in our membership. The directory also includes a history of the Association, which was organized to promote cooperative acquaintance among our members and for the discussion of medical and surgical problems of particular interest to the men engaged in this work. For many years the meetings have been held in Chicago, a central location for our widely distributed national and international membership.

THE Sixty-Second Annual Meeting will be held at the Drake Hotel, April 4 to 6, 1950. The excellent scientific program will include papers on timely and practical subjects, given by men who are recognized authorities in their fields.

To all Railway Surgeons and to others interested in the field of industrial medicine and surgery, I extend a most cordial invitation to attend this meeting. There is no registration fee. The Annual Banquet is planned for the evening of Wednesday, April 5, at the Drake, and all who attend will be assured an excellent dinner and an interesting evening.

There are still some physicians and surgeons in the United States and Canada who are Railway Surgeons and are not members of our Association. I urge them to become members. The requirements include the appointment on the staff of one of the railroads and membership in the American Medical Association. The membership fee is $5.00 annually. This includes an annual subscription to INDUSTRIAL MEDICINE AND SURGERY which is the Official Journal of the Association and which prints many of the scientific papers presented at the Annual Meetings. Membership application blanks may be obtained by writing directly to the Secretary of the Association.



American Association of Railway Surgeons

A Brief History

Edited by R. B. KEPNER, M.D.

THE AMERICAN ASSOCIATION OF RAILWAY SURGEONS evolved from an idea in the mind of DR. ALBERTUS WARD RIDENOUR, who was city health officer of Massillon, Ohio, and surgeon for several railroads. In the fall of 1887, at a meeting of the Association of Surgeons of the Pennsylvania Railroad in Alliance, Ohio, DR. RIDENOUR proposed the formation of a national organization of railway surgeons. LEANDER FIRESTONE, President of the Pennsylvania's Association, appointed an organizing committee, and DR. CHRISTIAN BERRY STEMEN, chairman of the committee and editor of the *Fort Wayne Journal of the Medical Sciences*, gave notice in his journal of a meeting open to all American railway surgeons, to discuss the formation of a national organization.

On June 28, 1888, over 150 surgeons, representing more than 60 railroads, met at the Palmer House in Chicago to form the National Association of Railway Surgeons. The first president was DR. JOHN WESLEY JACKSON, Chief Surgeon of the Wabash Railroad. The first secretary was DR. STEMEN, and the first treasurer was DR. ROBERT F. HARVEY REED, at one time Chief Surgeon of the Baltimore & Ohio Railroad. DR. STEMEN'S *Fort Wayne Journal* was made the official publication of the National Association, and from September, 1888, to July, 1891, the publication was issued monthly as the journal of the National Association of Railway Surgeons.

At the second annual meeting, held in St. Louis, May 2-3, 1889, attended by 500 surgeons, the executive committee, headed by DR. WARREN B. OUTTEN, Chief Surgeon of the Missouri Pacific Railroad, presented the first draft of the constitution of the Association.

The third annual meeting was held in Kansas City, Missouri, May 3, 1890, with 600 surgeons present, and DR. JAMES BISSETT MURDOCH, presiding. Certain revisions were made in the constitution, and a hospital plan discussed at this meeting was the forerunner of the modern industrial hospitalization insurance.

The fourth meeting, held in Buffalo, New York, under the presidency of DR. OUTTEN, produced the first volume of the Association's transactions. DR. REED'S detailed Historical Sketch of the Association appeared in this issue. The transactions of the fifth (1892) and the sixth (1893) meetings likewise appeared, all three being published by the *Railway Age* and the *Northwestern Railroader*, which in 1891 superseded the *Fort Wayne Journal* as the Association's official organ.

At the seventh annual meeting, in Galveston, Texas, in 1894, the Association decided to support a journal of its own, and the *Railway Surgeon*, with DR. REED as editor, was inaugurated June 5, 1894. Also at this meeting, under the presidency of DR. S. S. THORNE, the question of resolving the Association into a delegatory body was discussed. However, instead of changing the nature of the Association, a small group of doctors devoted to surgery, and influential outside the field of railway service, founded the American Academy of Railway Surgeons, limited to 200 active Fellows. Meetings were held in Chicago, and the transactions appeared in 10 volumes, 1894 to 1903, volumes 8-9, (1901-1902), being published in the *Railway Surgeon*.

Meanwhile, the National Association was incorporated in 1897 in Illinois, and, with extension of membership to Mexican and Canadian surgeons in 1898, the organization became the International Association of Railway Surgeons.

The two organizations got together in Chicago in June, 1904, and in joint session formed the AMERICAN ASSOCIATION OF RAILWAY SURGEONS, with DR. JOHN E. OWENS, Chief Surgeon of the Illinois Central, as president, and DR. ALBERT I. BOUFFLEUR, of the Chicago, Milwaukee & St. Paul, as chairman of the constitution committee. The plan of the organization was a modification of that of the American Medical Association, with branches on the different railroads. Permanent membership in the central body was limited to 200, with the delegates having all the privileges of the permanent members except in the work of the executive sessions. Thus, the good features of both the International Association and the Academy were covered.

Between 1904 and 1935, through several evolutional processes in changes of ownership and mergers, the *Railway Surgeon* finally became the journal INDUSTRIAL MEDICINE, which was adopted as the official organ of the Association. In 1949 the title of the journal was changed to INDUSTRIAL MEDICINE AND SURGERY.

FROM 1935 to 1941, inclusive, meetings were held annually at the Palmer House in Chicago. In 1942, on account of wartime conditions, restrictions on travel, etc., it was necessary to cancel all plans and preparations, which were well under way, for the meeting that year, and no meetings were held from 1942 to 1945, inclusive. During this period, the Association was kept alive in the minds of its members through the sustained activity of the Executive Committee headed by DR. ARTHUR R. METZ, Chief Surgeon of the Chicago, Milwaukee, St. Paul & Pacific Railroad and Chairman of the Executive Board of the Association. The work of the Executive Committee in frequent meetings called by DR. METZ resulted in defining and setting forth concretely the purposes of the Association and the adoption of an official seal, both of which appear

on the Certificate of Membership, which was designed and issued in 1943 for the first time in the history of the Association. The members were kept informed of the results of the Committee's efforts and plans for the future, and other physicians engaged in railroad medicine and surgery were circularized, with the result that not only was a decline in membership avoided but at the time meetings were resumed the roster showed some increase.

With resumption of annual meetings in November, 1946, interest in the Association among railway surgeons throughout the country was naturally stimulated, and membership mounted rapidly to more than 3,000.

In 1948 the AMERICAN ASSOCIATION OF RAILWAY SURGEONS celebrated its 60th anniversary meeting, with a record attendance and a program that was unsurpassed in any other similar assembly. At this meeting it was decided to change to early spring meetings to avoid conflict with other medical and surgical society meetings, a great preponderance of which are held in the fall. It was voted to hold a mid-year meeting in 1949, and the first spring meeting in 1950. The 1949 assembly was held at the Drake Hotel in Chicago, June 30 to July 2, inclusive, and was highly successful from the standpoint of attendance, enthusiasm, and excellence of the program presented.

American Association of Railway Surgeons
62nd Annual Meeting
April 4-6, Drake Hotel, Chicago
—Program—

FOLLOWING is the complete program for the Sixty-Second Annual Meeting of the AMERICAN ASSOCIATION OF RAILWAY SURGEONS, at the Drake Hotel, Chicago, on Tuesday, Wednesday and Thursday, April 4, 5 and 6, 1950. The Program Committee includes DR. CHESTER C. GUY, Chairman, DR. ROBERT M. GRAHAM, DR. RAYMOND B. KEPNER, DR. T. L. HANSEN, and DR. JAMES K. STACK. As many as possible of the papers presented at this meeting will be published throughout the year in INDUSTRIAL MEDICINE AND SURGERY.

Tuesday, April 4, 1950

DIAGNOSIS and Treatment of Bursitis"—GEORGE APFELBACH, M.D., Associate Professor, Bone and Joint Surgery, Northwestern University Medical School; Attending Surgeon, Cook County and Grant Hospitals, Chicago.

"The Use of Morphine and Scopolamine in Surgery"—RAYMOND HOUSEHOLDER, M.D., Clinical Associate in Surgery, Northwestern University Medical School; Senior Attending Staff, Wesley Memorial Hospital, Chicago; Surgeon, Chicago, Milwaukee, St. Paul & Pacific Railroad.

"Antihistamine Therapy"—SAMUEL M. FEINBERG, M.D., Associate Professor of Medicine, Chief of Allergy Division and Director of Allergy Research Laboratories, Northwestern University Medical School; Attending Physician, Passavant Memorial Hospital, Chicago.

"The Cause and Prevention of Venous Thrombosis"—ALTON OSCHNER, M.D., William Henderson, Professor of Surgery and Chairman of the Department of Surgery, School of Medicine, Tulane University; Director of General Surgery, Ochsner Clinic and Foundation Hospital; Consulting Surgeon, Illinois Central Hospital and the Southern Pacific Railroad.

"The Diagnosis and Treatment of Traumatic Lesions of the Spinal Cord"—PAUL BUCY, M.D., Professor Neurological Surgery, University of Illinois College of Medicine; Attending Neurological Surgeon, Chicago Memorial Hospital.

"Compound Fractures of the Skull"—JOHN P. GALLAGHER, M.D., Assistant Professor of Neurological Surgery, Attending Neurological Surgeon, Georgetown University Hospital, Washington, D. C.

"The Use of Intravenous Procaine in Trauma"—DAVID J. GRAUBARD, M.D., and HARRY V. SPAULDING, M.D., Company Surgeons, Baltimore & Ohio Railroad, New York.

"Atlas of Pathologic Anatomy of Trauma"—JERRY J. KEARNS, M.D., Pathologist, Coroner, Cook County, Illinois; Asst. Professor, Clinical Pathology, University of Illinois College of Medicine.

Wednesday, April 5, 1950

SYMPOSIUM on Problems in Abdominal Surgery:
"The Diagnosis and Treatment of Pancreatitis"—HARRY OBERHELMAN, M.D., Professor and Chairman, Department of Surgery, Stritch School of Medicine, Loyola University; Attending Surgeon, Cook County and Mercy Hospitals, Chicago.

"Acute Bowel Obstruction with Method of Bowel Decompression"—CLAUDE J. HUNT, M.D., Chief of Surgical Service, Research Hospital, Kansas City General Hospital; Attending Surgeon, Menorah Hospital, St. Mary's Hospital, and St. Joseph's Hospital; Consulting Surgeon, Chicago, Milwaukee, St. Paul & Pacific, and Missouri Pacific Railroads.

"The Rationale of a Single Operation for the Repair of all Groin Hernias"—CHESTER B. MCVAY, M.D., Ph.D., Clinical Professor of Surgery, South Dakota University School of Medicine, Yankton, South Dakota.

"Treatment of Carcinoma of the Left Half of the Colon and Rectum"—KARL A. MEYER, M.D., Professor of Surgery, Northwestern University; Chairman, Department of Surgery, Cook County Hospital; Consulting Surgeon, Illinois Central and C. & E. I. Railways; and PETER A. ROSI, M.D., Associate Professor, Department of Surgery, Northwestern University; Attending Surgeon, Cook County and Wesley Hospitals, Chicago.

SYMPOSIUM on Problems in Internal Medicine:
"The Problem of Hypertension"—JAMES H. HUTTON, M.D., Consulting Endocrinologist, Illinois Central Railroad, C. & E. I. Railroad, and Carnegie-Illi-

nois Steel Corporation; Chairman of the Editorial Board, *Illinois Medical Journal.*

"Anticoagulant Therapy in Cardiovascular Diseases"—OVID O. MEYER, M.D., Professor and Chairman, Department of Medicine, University of Wisconsin Medical School, Madison, Wisconsin.

"Diabetes in Railroad Employees"—H. IVAN SIPPY, M.D., Assistant Professor of Clinical Medicine, Northwestern University School of Medicine; Consulting Physician, Chicago, Milwaukee, St. Paul & Pacific Railroad; Senior Staff, Wesley Memorial.

"The Use of ACTH in Treatment of Rheumatoid Arthritis and other Collagen Diseases"—D. E. MARKSON, M.D., Assistant Professor and Director, Arthritis Clinic, Northwestern University Medical School; Attending Staff, Wesley Memorial.

ANNUAL DINNER, Drake Hotel, Wednesday, April 5: Fellowship Hour, 6:30 to 7:30 P.M.; Dinner, 7:30; DARWIN KIRBY, M.D., President of the Association, Toastmaster.

Thursday, April 6, 1950

SYMPOSIUM on Disorders of Upper Extremity:

"Tendon Injuries"—SUMNER KOCH, M.D., Professor of Surgery, Northwestern University Medical School; Attending Surgeon, Passavant Memorial Hospital, Chicago.

"Amputations in the Upper Extremities"—HENRY H. KESSLER, M.D., Director, Kessler Institute for Rehabilitation, West Orange, New Jersey.

"Carpal Injuries"—KELLOGG SPEED, M.D., Clinical Professor of Surgery (Rush) University of Illinois College of Medicine; Attending Surgeon, Presbyterian Hospital, Chicago.

"The Diagnosis and Treatment of the Painful Shoulder"—JAMES K. STACK, M.D., Assistant Professor, Orthopedic Surgery, Northwestern University Medical School; Attending Surgeon, Cook County and Passavant Memorial Hospitals; Chief Surgeon, Chicago & North Western Railroad.

"The Use of Intramedullary Fixation in Fractures"—HAROLD A. SOFIELD, M.D., Associate Professor of Bone and Joint Surgery, Northwestern University Medical School; Chief Surgeon, Shriners Hospital for Crippled Children; Chairman of the Department of Orthopedic Surgery, West Suburban Hospital, Oak Park, Illinois; Secretary of the American Board of Orthopedic Surgery.

"Injuries of the Peripheral Nerves"—Film directed by DR. LOYAL DAVIS, Professor and Chairman of Department of Surgery, Northwestern University Medical School, Chicago. Discussion by DR. JOHN MARTIN, Assistant Professor of Surgery, Northwestern University Medical School.

"Fracture Movie"—Official Film of the Committee on Fractures, American College of Surgeons.

Exhibitors

THE EXHIBITORS at the Sixty-Second Annual Meeting of the AMERICAN ASSOCIATION OF RAILWAY SURGEONS include the following. The time schedules of all sessions provide for numerous intermissions during which the exhibits may be visited and inspected.

Americaine, Inc.
American Medical Association.
Ames Company.
Anahist Co., Inc.
Bristol-Myers Company.
Cameron Heartometer Company.
Ciba Pharmaceutical Products, Inc.
Coca Cola Company.
Doho Chemical Corp.
Encyclopaedia Britannica, Inc.
Keystone View Company.
Medco Products Co.
Mine Safety Appliances.
Morris, Phillip, & Co.
Parke, Davis & Co.
Rystan Company, Inc.
Scholl Mfg. Co., Inc.
Young, F. E., & Co.

Orchids to Ayer

WHO PAYS the bill for worker benefits? Ultimately, the consumer—the man or woman who buys what industry has for sale. Worker benefits, in any business, must be treated as a cost item—just like raw materials, wages, taxes, rent and all other costs that go to establish the selling price. Some people believe it a simple matter for business to give pensions of $100 a month to all employees. To fund such a program for the corporations alone, which employ nearly two-thirds of all the people now working, would cost approximately 52 billion dollars. In addition to the original fund there will be annual payments to maintain it. No one knows what this cost will be, but estimates range from 4 to 12 billion dollars a year. When you consider, however, that the average total profits of all corporations over the past 20 years have been only 6½ billion dollars a year, it is plain that business cannot absorb such changes. It is natural for every worker to want all the benefits he can get. It is intelligent for management to provide all the benefits the business can stand—so long as such charges do not raise prices to consumers to the point where buyers are destroyed, or make it impossible for management to reward outstanding employees adequately, or destroy the flow of new capital so important to growth. But since worker benefits—pensions, insurance plans, medical expenses, etc.—must be regarded the same as all other costs that make up the selling price, it is the responsibility of management to tell its customers—all of America—where the trend is bound to lead.

—Full page advertisement of N. W. AYER & SON, INC., in *Saturday Evening Post*, January 28, 1950, reprinted here by special permission.

AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS

PRESIDENT'S PAGE

AT THIS midway point of the "Chemical Century," and working daily with source material which has been collected during the past seven years—material dealing with the earliest knowledge of occupations and their hazards and effects upon the worker, the increasing importance of this field as the centuries passed, and, with the present century, the sudden rush of knowledge concerning the worker and his health, the influence of his environment, his nutrition, his opportunities for recreation, and the psychological and economic factors involved in his existence—I am impressed with the importance of the worker and the Doctor who acts as his protector.

This importance is reflected by the stature which the AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS has attained, and further emphasis is indicated by the more recent activities of the American College of Surgeons in its survey of Medical Services in Industry and certification of qualifying medical departments, and by the rapidly expanding work of the Council on Industrial Health of the American Medical Association with its enlarged staff and its industrial Health Conferences in various parts of the country.

The importance of occupational health is also shown by the Official Journal of our Association, INDUSTRIAL MEDICINE AND SURGERY, now under the editorial direction of DOCTOR CAREY PRATT McCORD and DOCTOR JEAN SPENCER FELTON, by the establishment of the *Archives of Industrial Hygiene and Occupational Medicine* sponsored by the American Medical Association under the editorship of PROFESSOR PHILIP DRINKER, by the formation of the AMERICAN ACADEMY OF OCCUPATIONAL MEDICINE, by the constantly increasing number of Component Societies of the AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS, by the President's Conferences on the Prevention of Accidents in Industry, and by the rapid expansion of the Department of Industrial Hygiene of the U.S. Public Health Service and the many state and city Industrial Health Divisions.

A recent event of unusual significance was the granting of the Degree of DOCTOR OF INDUSTRIAL MEDICINE to three candidates at the Winter Convocation of the University of Pittsburgh.

EACH year, accomplishments in the field of industrial health pass in review at the Annual Conference of our Association held in conjunction with the Annual Meetings of the AMERICAN ASSOCIATION OF INDUSTRIAL NURSES, the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION, the AMERICAN ASSOCIATION OF INDUSTRIAL DENTISTS and the AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS.

Last year at Detroit, the quality of the program and the large attendance established the Conference as one of the most important medical meetings of the year. The outstanding program arranged for the 1950 Conference to be held at the Hotel Sherman in Chicago starting April 22 indicates that the Conference this year will be even more impressive, and an event which no one working in any of the fields of occupational health can afford to miss. The impressive list of exhibitors shows that the equipment and pharmaceutical industries understand the tremendous purchasing power which the participants in this Conference represent.

In conclusion, I should like to invite the physicians, the nurses, the dentists, the industrial hygienists, and the many friends of these groups who are found in the legal profession, the insurance industry, the field of hospital administration, and the administration of workmen's compensation to attend the Chicago Conference to review the progress of the past year, to meet others with kindred interests, and to inspect the exhibits and attend the interesting program of hospital clinics.

G. H. W. Whittaker, M.D.

Chicago Conference on Industrial Health

—Program Features—

Chicago, April 22-29, 1950

THE Preliminary Program of the Conference on Industrial Health, to be held in Chicago, April 22-29, 1950, was published in INDUSTRIAL MEDICINE AND SURGERY for January. Among the features which have been added in the development of the final program are the details of the Medical and Surgical Clinics on Monday and Tuesday, and the full programs of the six Section Meetings on Tuesday afternoon, together with some added papers on the other days. All meetings are to be at the Hotel Sherman.

THE participating organizations and the dates of their meetings are as follows:

AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS—April 24, 25, 26, 27, 28.

AMERICAN ASSOCIATION OF INDUSTRIAL NURSES—April 23, 24, 25, 26, 27, 28, 29.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS—April 22, 23, 24, 25.

AMERICAN INDUSTRIAL HYGIENE ASSOCIATION—April 25, 26, 27.

AMERICAN ASSOCIATION OF INDUSTRIAL DENTISTS—April 25, 26, 27.

Clinics

Monday Afternoon, April 24

OPERATIVE Clinic, Cook County Hospital:

"Custom Built Inguinal Herniotomy" — DR. MANUEL LICHTENSTEIN.

"Open Reductions of the Fractured Neck of the Femur: Present Concept of the Treatment of the Injury"—DR. CARLO SCUDERI.

"Gastric Resection"—DR. PETER ROSI.

Monday Afternoon, April 24

MEDICAL Clinic, St. Luke's Hospital:

"Traumatic Thromboses"—DR. GAZA DE TAKATS.

"Cartilage Cup Arthroplasty"—DR. FREMONT A. CHANDLER.

"Patelloctomy"—DR. JOHN R. NORCORSS.

"Rehabilitation in Industrial Injuries"—DR. ROLAND A. JACOBSON.

"Recurrent Hernias"—DR. BURTON C. KILBOURNE.

"Intra-medullary Pinning in a Monteggia Fracture"—DR. CHARLES E. SHANNON.

"Problems in Chronic Wound Therapy"—DR. PAUL GREELEY.

"Roller Injuries with Avulsion of Skin"—DR. HARRY E. MOCK, JR.

"Old Non-union Sub-trochanteric Fracture of Femur: Reconstruction"—DR. CLAUDE LAMBERT.

Tuesday Morning, April 25

MEDICAL Clinic, Cook County Hospital:

"Severe Crushing Injuries of the Hand"—DR. MICHAEL MASON.

"Delayed Surgical Excision in the Treatment of Burns"—DR. HARVEY S. ALLEN.

"Comminuted Fractures into the Ankle Joint"—DR. EUGENE A. HAMILTON.

"Disability of the Os Calcis, Including Fractures"—DR. FRANK G. MURPHY.

A.A.I.P. & S. Section Meetings

Tuesday Afternoon, April 25

Section on Workmen's Compensation and Insurance

PRESIDING: DR. CARL T. OLSON, Section Program Chairman:

"Medicolegal and Social Problems of Non-Occupational Temporary Disability Benefits"—MARY DONLON, Chairman, New York State Workmen's Compensation Board, New York City.

"Medicolegal and Social Problems in Permanent Disability Cases"—ASHLEY ST. CLAIR, Home Office Legal Counsel, Liberty Mutual Insurance Company, Boston.

Should There be Free Choice of Physicians Under Workmen's Compensation?"—HARRY A. NELSON, Director, Workmen's Compensation, Industrial Commission, Madison.

"The Philosophy and Implications of Fee Schedules"—DR. BEN FREES, Retiring President, Los Angeles County Medical Association, Los Angeles.

Section on Hand and Restorative Surgery

PRESIDING: DR. WILLIAM F. LAUTEN, Section Program Chairman:

Introductory Remarks and Announcements by Chairman.

Part I—Moderator: DR. BURTON C. KILBOURNE, Chicago:

"Common Causes of Foot Disabilities and Their Treatment"—DR. CARLO SCUDERI, Associate Professor of Surgery, University of Illinois.

"Treatment of Injured Hand"—DR. CONDIT W. CUTLER, JR., New York City; Author, "The Hand, Its Disabilities and Diseases."

"Stenosing Tenovaginitis of the Hand" (Slides)—DR. LEO F. MILLER, Associate Orthopedic Surgeon, University of Illinois.

"Reconstructive Surgery of the Hand and Industrial Rehabilitation" (Slides) — DR. MICHAEL L. LEWIN, New York City, Attending Plastic Surgeon, Halloran Veterans Administration Hospital.

PART II—MODERATOR: DR. ALLAN K. HARCOURT, Indianapolis:

"Problems Associated with Fractures of the Carpal Navicularis"—DR. JAMES K. STACK, Chief Surgeon, C. & N. W. R.R.; Associate Professor, Bone and Joint Surgery, Northwestern University Medical School.

"Common Hand Injuries"—DR. FRANK W. BARDEN, Medical Director, Saco-Lowell Shops, Biddeford, Maine.

PRESIDING: DR. WILLIAM F. LAUTEN, Section Program Chairman:

Panel Discussion: Evaluation of Deformity and Disfigurement.

Panel Participants: BURTON C. KILBOURNE; CARLO SCUDERI; CONDIT W. CUTLER, JR.; LEO F. MILLER; MICHAEL L. LEWIN; ALLAN K. HARCOURT; JAMES K. STACK; FRANK W. BARDEN.

Section on General Manufacturing

PRESIDING: DR. MARION W. JOCZ, Section Program Chairman:

"Diagnostic Time Savers in Internal Medicine"—

DR. JOHN G. BIELAWSKI, Executive Director, Section on Industrial Cardiology, Michigan Heart Association.

"Diagnostic Time Savers in Surgery"—DR. BROCK E. BRUSH, Associate Surgeon, Henry Ford Hospital.

"How Big is the Problem of Certain Industrial Diseases?"—DR. ALBA D. RUSH, Staff Specialist in Charge of Industrial Hygiene, Chrysler Corporation.

"The Little Man Who's Always There"—HARRY BANKS BURR, Business Manager and Statistician, Chrysler Medical Department.

Section on Steel and Heavy Industries

PRESIDING: DR. PAUL BAMBERGER, Section Program Chairman:

"The Physiology of the Cardiovascular System in Relation to Heat and Strenuous Effort"—DR. SIMON RODBARD, Asst. Director, Cardiovascular Department, Medical Research Institute, Michael Reese Hospital, Chicago.

"Occupational Diseases and the Heart"—DR. O. A. SANDER, Consultant in Industrial Medicine, Milwaukee, Wisconsin.

"Heart Disease and the Periodic Industrial Health Examination"—DR. L. A. WHITAKER, Chief Surgeon Weirton Steel Co., Weirton, West Virginia.

"Case Finding and the Medical Supervision of Cardiacs in Industry"—DR. LAWRENCE T. SMYTH, Plant Physician, Bethlehem Steel Co., Bethlehem, Pennsylvania.

Section on Petroleum, Rubber and Chemicals

PRESIDING: DR. REX H. WILSON, and F. S. MALLETTE, Co-Chairmen Section Program:

"Chemical Carcinogens"—DR. J. R. HELLER, JR., Director, National Cancer Institute, Bethesda, Maryland.

"Injuries Resulting from Exposure to Ethylene Oxide"—DR. R. J. SEXTON, Medical Director of the Institute, and DR. E. V. HENSON, Assistant Medical Director, Carbide and Carbon Chemicals Division, Union Carbide & Carbon Corporation.

"Industrial Hygiene Codes"—(A comprehensive discussion of industrial hygiene codes as they affect the industrial hygienist and the industrial physician)—DR. JAMES H. STERNER, Associate Medical Director, Eastman Kodak Company, Consultant, Atomic Energy Commission.

"Parachloronitrobenzene, Cyclohezylamine, Alpha Aminopyridine: Observations of their Toxicity in Industry"—DR. R. M. WATROUS, Plant Physician, and HOWARD N. SCHULZ, Industrial Hygiene Chemist, The Abbott Laboratories.

Section on Mining Industry

PRESIDING: DR. CHARLES BROWN STACY, Co-Chairman Section Program:

"General Considerations of Physical Rehabilitation"—DR. HENRY H. KESSLER, Medical Director, New Jersey Workmen's Compensation Bureau, Newark, New Jersey.

"The Functions of the State Program in the Rehabilitation of Disabled Miners"—M. M. WALTER, Director, Bureau of Rehabilitation, Pennsylvania State Board of Vocational Education, Harrisburg, Pennsylvania.

Movie: "Comeback"—The physical and vocational rehabilitation of an injured workman.

"Respiratory Physiology with Particular Reference to Chronic Pulmonary Disability"—DR. CAMPBELL MOSES, JR., Director, Addison H. Gibson Laboratory, University of Pittsburgh School of Medicine, Pittsburgh.

"Considerations of the Clinical and Physiologic Factors in the Treatment of Silicosis"—DR. BURGESS GORDON, Clinical Professor of Medicine, Jefferson Medical College, and Director of the Barton Memorial and White Haven Division, Jefferson Hospital, Philadelphia.

PRESIDING: DR. DANIEL C. BRAUN, Co-Chairman Section Program:

Panel Discussion on Economics of Medical Practice in Coal Mining Communities:

Panel Participants:

DR. CHARLES B. STACY, Association of Mine Physicians, Pineville, Kentucky.

DR. DANTE PIGOSSI, Mine Physician United States Steel Company National 1 and 3 mines, Bridgeville, Pennsylvania.

DR. E. L. BORKON, President, Holden Hospital Staff, Carbondale, Illinois.

DR. FREDERICK W. SLOBE, Medical Director, Chicago Blue Cross Plan, Secretary of the AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS.

MR. T. E. LIGHTFOOT, Director of Insurance and Welfare, Eastern Gas and Fuel Associates, Pittsburgh.

DR. WARREN DRAPER, U.M.W.A. Health and Welfare Fund, Washington, D. C.

DR. LESLIE FALK, U.M.W.A. Health and Welfare Fund, Pittsburgh.

DR. JOHN MORRISON, U.M.W.A. Health and Welfare Fund, Charleston, West Virginia.

American Association of Industrial Dentists

Tuesday, April 25

BOARD of Directors Meeting.

Annual Meeting and Election of Officers.

"Oral Health Programs in Industry"—EARLE H. THOMAS, M.D., D.D.S., Chicago.

"Analysis and Presentation of Dental Data Obtained Through Surveys"—WALTER F. HOFFMANN, D.D.S., M.P.H., Representing A.C.G.I.H., Washington, D. C.

"Proposed Dental Activities in a State Industrial Hygiene Program"—L. M. PETRIE, M.D., Georgia Department of Public Health, Representing A.I.H.A., Atlanta.

Wednesday, April 26

OCCUPATIONAL Disease Manifestations in Dental Impairments"—CAREY P. MCCORD, M.D., Medical Director, The Industrial Conservancy Laboratories, Detroit.

"Dentistry in The Ford Motor Company"—GRANT MCKENZIE, D.D.S., Dentist-in-charge Rouge Division, Ford Motor Company, Dearborn, Michigan.

Round Table Discussion—Oral Health Needs of the Industrial Population—Their Meaning and the Response of Various Groups:

Local Needs; Statewide Needs; Governmental Response; Labor Response; The Professional Response.

Thursday, April 27

INDUSTRIAL Tour covering dental service at local plants.

Joint Meeting with all participating groups.

"Teamwork—for Effective Industrial Health."

Panel Session—Moderator: GENERAL FRED GILLIES.

Exhibitors

THE EXHIBITORS at the Chicago Conference on Industrial Health include the following. The schedules of all the sessions, including the Section Meetings, are timed to provide for numerous intermissions during which the exhibits may be inspected.

Aloe, A. S.
American Medical Association.
American Optical Co.
Americaine, Inc.
Ames Co., Inc.
Anahist Company, Inc.
Archer Taylor Drug Co.
Armour & Co.
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ASSOCIATION NEWS

A.A.I.P. & S. Annual Meeting

THE Annual Meeting of the AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS will be held in the Hotel Sherman, Chicago, on Wednesday afternoon, April 26, at 4:30. Association matters, reports of Officers and Committees, and election of Directors and Officers will be the order of business at that time.

From Ireland

TO DR. F. W. SLOBE, Secretary, AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS:

The Association of Industrial Medical Officers of Ireland was founded about three years ago, although prior to that date some Irish doctors had been members of the English Association.

Ireland is not highly industrialized, being mainly an agricultural country, so her industries are small. Brewing, distilling, biscuit manufacture, weaving and dairy products are the main native industries. For this reason it will be obvious that, as we lack heavy injuries and dangerous trades, industrial medicine had not been established at an earlier date. Our membership is not large, but the members are keen and anxious to be informed of developments in industrial medicine elsewhere.

As a result of the comparative youth of the Association we do not as yet publish a Journal, but many of our members are subscribers to your publication. I am a whole-time Industrial Medical Officer, working as a consultant to a number of firms handling a variety of products, ranging from beer, yeast extract, soap, cosmetics, glycerine, petrol and lubricating oils to pharmaceutical products. As a result I am fortunate in having an interesting life, as a new problem arises almost daily.

The largest firm I am associated with is Arthur Guinness Son & Co. Ltd., who brew "Guinness is Good for You," and who have a long and close association with industrial medicine. They established a Medical Department in 1870, and today they have a very fine scheme for their employees and their families, everything from sick pay to pensions being provided as a free gift of the firm. This may be somewhat repugnant to the American mind, as I gather that you as a nation prefer to pay for everything you get, but over here we feel that it is really something which would not be possible if the scheme were entirely contributory. Ireland has not followed the English lead in being a "Welfare State," and here it is still the duty of the individual to pay his own doctor.

Every member of the Irish Association would be delighted to attend the annual convention in Chicago, but unfortunately shortage of dollars and sterling are potent arguments against their making the trip. They all join with me in wishing you a most successful meeting.

—DR. JOHN F. EUSTACE,
Hon. Secretary & Treasurer.

In Porto Rico

ON FEBRUARY 1-4, 1950, a conference and symposium on rehabilitation was held at the School of Tropical Medicine in Porto Rico, with outstanding authorities on rehabilitation from several countries. This was sponsored by the State Insurance Fund, Department of Physical Medicine and Rehabilitation, of Porto Rico; the Porto Rico Department of Health, Bureau of Crippled Children; the Department of Education, Office of Vocational Rehabilitation, of Porto Rico; and the International Society for the Welfare of Cripples, Cleveland, Ohio. This meeting has done much to call the attention of workers, the medical profession, management and government officials to the possibilities of a comprehensive rehabilitation program in industry.

INDUSTRIAL MEDICINE AND SURGERY

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Siderosis — A Milestone

OVER the years, the term "siderosis" has undergone vicissitudes. In the fashion of Humpty-Dumpty, who declared that words meant what he wanted them to mean, "siderosis" has meant different things to different men at different times. For a period, any dusty lung disease appearing among iron or steel workers was siderosis, solely so designated on the basis of trades. Thus silicosis, was, by wide consent, labeled "siderosis." Concurrently, other physicians were committed to the practice of styling any phthisis among any metal workers as "siderosis." On this basis, the silicosis of the gold miner became siderosis. A wider departure appeared in the concept that the deposition of iron in any tissue constituted siderosis. In this manner tattooing of an arm became a variety of siderosis. At least as early as 1914 Gilman Thompson observed, with siderosis in mind, "the nomenclature of the occupational diseases is complex enough without such unscientific additions." Long since such vagueness has given way to the more exact belief that the term "siderosis" should be reserved to designate a benign form of pneumoconiosis deriving from the entry of ferrous particles into the lower respiratory tract.

IN THE world of constructive contributions to medicine, there are at least two broad categories. One of these is the *de novo* disclosure of a single or a few major discoveries. Of this sort, the achievement of Banting and Best in the isolation of insulin is the perfect example. The second category embraces the work of the major-scale appraiser, the scientific organizer, the tosser-out of feeble values. An apt example is found in the medical activities of Osler. The first creates masterpieces in miniature. The second, with broader strokes, creates masterpieces in murals. Each in its own manner makes medicine more substantial.

This issue of INDUSTRIAL MEDICINE AND SURGERY publishes the results of investigations on siderosis by HAMLIN and WEBER, and by VORWALD and his associates, in merited unrestricted space provision. The reading of these significant records provides conviction that these investigators fall into both the categories just mentioned. At one and the same time they pursue the minutiae of scientific exactness but still present the import of siderosis in its widest implications. This is a milestone.

In science, the temptation is often, and great, to mark an achievement as final.... the completion of the answer to a need. Only the unwary fall into that trap. In medicine nothing is final. However superb the qualities of these publications may be, the authors themselves would be the first to deny finality, and would resent any such designation by others. Conforming to the belief that all good medicine is in progression, these presently published records of thorough inquiry pridefully may be regarded as stations along the way to the infinity of medical perfection,—but major stations for the guidance of all industrial physicians in their consideration of the consequences of the introduction of iron dust into the lungs of industry's workmen.

Health in the Smog

STUDIES regarding the nature and control of atmospheric pollution are not new. Our friends in the fields of engineering, chemistry, plant physiology and, more recently, meteorology have met together from time to time and over the past years to present to each other new data gathered within their respective fields. They were not concerned with the health aspect of the problem. Nor, to any appreciable extent, was the medical profession.

But after the Donora catastrophe came the deluge. Smog symposia became as frequent and ubiquitous as Parent-Teacher meetings. In the

past two years practically all of these have been sponsored by a medical or public health organization of some type, the intimation being that from them would come information that would have practical meaning for the doctor of medicine as well as the industrial hygienist. (The writer admits having been possessed of such a foolish dream when he organized a smog symposium for the American Medical Association last June.) But what subjects are presented at these convocations?

The answer is found in the reading of any of the numerous programs being offered. The recent Air Pollution Institute sponsored by the School of Public Health, University of Michigan, is a good example (Ann Arbor, February 6-8, 1950). This was of high calibre, as indicated by the seven papers which appeared in the March issue of INDUSTRIAL MEDICINE AND SURGERY. (Thirteen other papers are in the *Industrial Hygiene Quarterly* for March.) A further perusal of the entire program indicates that *only one paper* dealt with the physiological effects of atmospheric pollution. What was the subject matter of the remaining 19 papers? Here are some of the titles: "Atmospheric Sampling," "Behavior and Chemistry of Air Contaminants," "Gravitational and Centrifugal Separation," "Electrostatic Precipitation," and so on. In short, one-twentieth of the time was devoted to the physiologic aspect of the problem.

At the aforementioned Institute DR. CAREY P. MCCORD read a paper on the physiological effects of atmospheric pollution, at the conclusion of which he said: "Much of the foregoing is—as was planned—a confession of ignorance." The confession of DR. MCCORD, and others of us interested in the problem, is an admirable starting point for future investigations. Unfortunately such an attitude is not shared by most of the medical profession, in which we find, by and large, two groups. One group denies the possibility, or at least the probability, of any actual harm from atmospheric pollution. The other group seems eager to utilize smog as a hat rack upon which to place the blame for diagnostic error or therapeutic failure. To wit, "Doctor, do you think my condition is due to (or made worse) by this terrible smog?" is too frequently answered with assent by the doctor.

THE situation is more serious than even the tenor of this editorial can possibly convey. It has been pointed out that phobias, neuroses and hysteria from fear of smog are on the increase. Even mass hysteria is not impossible. Property is sold at a loss because the owner desires to move to an area of pure air. Some industries are being sued unjustifiably by citizens in the immediate neighborhood. In some areas real estate cannot be sold. But over and above all this is the real question as to the relationship of atmospheric pollution to pneumonia, pulmonary tuberculosis and pulmonary cancer—to name only a few of the diseases now under suspicion. To date we have no answer which rests upon a scientific study. Even after the extensive survey of the Donora situation by the U. S. Public Health Service, DR. H. H. SCHRENK, who was in charge, stated, "nothing conclusive can be said"; "the survey has served to emphasize the areas of deficiency in the present knowledge of the overall problem of atmospheric pollution." Such is the status of a situation which is nearly as foremost in the minds of the public as the atom bomb.

WHAT should be done? It would seem obvious that this is, above all else, a research project, a study involving mice, men and money. Those who imagine that answers can be obtained by house to house inquiry or some small-scale investigation should be discouraged. The magnitude of the problem is tremendous, and it should be allied with the best university personnel and laboratory facilities. In any one area of study a half-million dollars should be the minimal financial backing. Under a thoroughly competent director of the investigation there should be a pathologist, physiologist, chemist, pharmacologist, toxicologist, internist, allergist, and others.

What can we expect from a real scientific investigation? Undoubtedly a great deal of negative information. That is, such a survey will almost certainly refute many of the false assumptions some hold regarding the harm from smog. But that is what we need. These negative results will have a positive value. It may also be that those who are skeptics will have to admit to a harm which they now deny.

Let us then try to speed the occasion when we can present to a medical audience *objective medical information*. Let us devote the time, money and energy now given to symposia to research. In short, it is time to stop talking and get to work. It is time to cease kidding the public or the profession that we as yet know anything about the health aspects of smog. Rather let us assure them that we are determined to learn.

—RUTHERFORD T. JOHNSTONE, M.D.

Reduce absenteeism and increase efficiency through COLD CONTROL

The effect of cold control on production costs will be readily apparent to all in management, and particularly to physicians charged with maintaining the physical fitness of plant or office personnel.

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*ANAHIST is the trademark of the Anahist Co., Inc. for its brand of Thonzylamine Hydrochloride.

1. Arminio, J. J., and Sweet, C. C.: Indust. Med. 18: 509 (1949). 2. Tebrock, H. E.: Indust. Med. 19: 39 (1950).

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Safety Short Short

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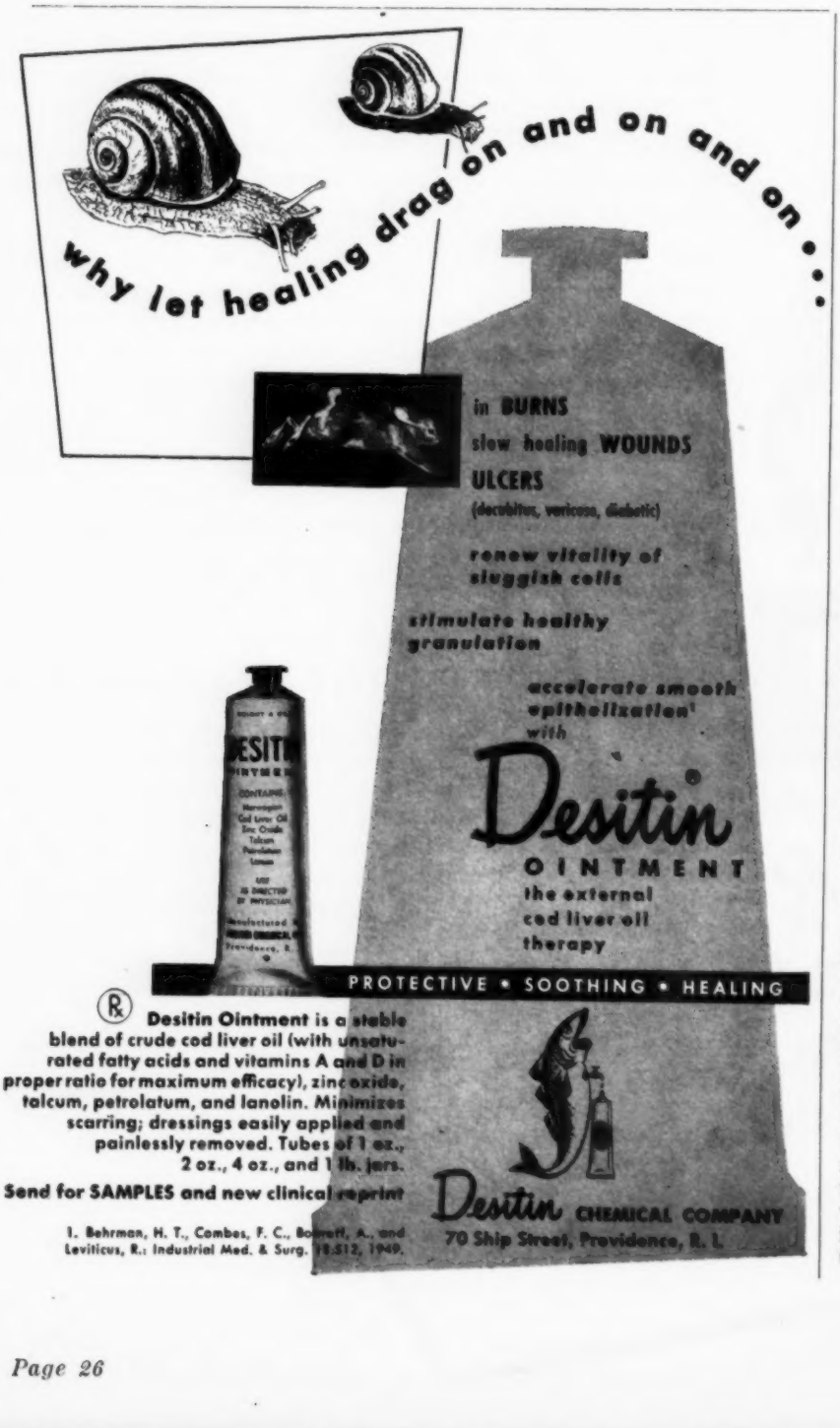
—LAWRENCE STASSEN in *Mill & Factory*, quoted in *Management Review*, January, 1950.

The Shadow

IF IT BE TRUE that an institution is but the lengthened shadow of a man, surely organized medicine must prepare to be judged by those doctors whom it authorizes or permits to represent organized medicine as it applies to workers.... If the contacts with workers and their medical problems are through little men, or men unfit for the social responsibilities they serve, the institutions they represent will shrivel to their own dwarfed proportions and finally become wholly useless.

—From an Address by MARY DONLON, Chairman, New York State Workmen's Compensation Commission, at the Tenth Annual Congress on Industrial Health, New York, February 20, 1950.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1. Behrman, H. T., Combes, F. C., Bonnell, A., and Leviticus, R.: Industrial Med. & Surg. 18:512, 1949.
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Keeping Them Happy

SINCE the war, a lot of women workers have switched from overalls and lathes to aprons and vacuum cleaners. And a lot of employers, to their own surprise, have watched the factory-to-fireside trek with regret. One firm, however, the Soss Manufacturing Company, which for a quarter-century has been employing women employees, says it takes some special treatment to satisfy the whims and fancies of feminine workers. But it pays off in a stabilized workforce, high morale, efficient plant operation. Here are Soss' tips on how to keep women workers happy: (1) Women in factories are as vain as their sisters outside. If they have grease-smudged faces, it's no sign they don't care how they look. Soss knows that women want to primp and preen when their shift is over. So it provides extra-large, chrome-plated well-lighted mirrors in rest rooms. (2) Women want locker rooms to be clean and ample. They grumble about conditions that men workers accept as a matter of course. So Soss has well-kept lockers with plenty of room for hats, shoes, and clothes—even for fur coats. (3) Women want plenty of hot water for cleaning up after the day's work. And a woman's idea about what is "hot" differs a lot from that of men. So Soss now sees to it that the hot water in the women's rooms is kept at a higher temperature than elsewhere. (4)

Women's faces and hands are more tender than those of men, so women are more particular about the kind of soap you give them. Soss uses a top-quality perfumed soap. It costs more, and doesn't get the grime off any better than the soap the men have; but the women's soap gripes stopped right away when the change was made. (5) Soss found years ago that women workers favor a more personalized employer-employee relationship than is customary for men. So the rule is: Know women employees by their first names; take time out to talk to them; always let them know that the company knows what they're doing—and appreciates it. (6) Women like to operate their "own" machines and equipment. They have a great pride of possession. They want "their" machines to be shipshape, and tools and supplies tidy. So Soss assigns machines to its women workers on a "for keep" basis, and never makes a change unless it is necessary.

—*Business Week*, November 26, 1949, quoted in the *Management Review*, March, 1950.

Deeply Hidden

THOSE who fatuously believe that all workers have been shorn of half their nerves of sensation need to have the scales beaten off their own minds. These same silly ones likewise may believe that the mental and emotional equipment of industrial workers is irresponsive to the shocks, stresses and strains that bring about the quirks and kinks in the affairs of these self-styled "superior" beings. (It may be true that only the elite may afford to indulge in the luxury of psychoanalysis and face a two thousand dollar bill for this service.) But in spite of the saving grace of long hours of toil, a high percentage of workers everywhere are handicapped by a world of neuroses—their own and those of their fellows. The industrial worker is highly vulnerable to the buffeting in his world. Like most of the rest of us he is beset by uncertainties, anxieties, insecurity, inferiority complexes, phobias, neuroses, fear of not fitting into his group, fear that he may be disliked, a little insecure as to his job, uncertain about the attitude of his foreman toward him, disturbed by troubles at home, a complaining wife, demanding children. His work world may be filled with noise, monotony, fatigue. For many, shortened hours of labor, however gladly accepted, only add to the burden of the worker's living. Scant opportunity for recreation, unattractive homes, few friends, limited satisfaction. Deeply hidden in the average workman are lonesomeness and anxiety.

—From "A Blind Hog's Acorns," by CAREY P. MCCORD, M.D., quoted in "Opportunities for Group Health Instruction in Industry," by F. S. PARNEY, M.D., in *Industrial Health Review*, 2:1. January, 1950, published by Industrial Health Division, Ottawa, Canada.

No doctor today can afford to be without adequate diathermy equipment.

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The "Common" Cold

MENTION must be made of the greatest nuisance disease in North America—the common cold. Of all the days lost from school for medical reasons in cities in Canada, 51.5% were lost because of upper respiratory infections, and of these, 59.8% were lost because of the common cold. In rural schools the figures were 46.8% and 59%. Adults would probably be surprised if they kept count of the number of days in a year when they are suffering from colds. No sure-fire preventive measure has yet been found,

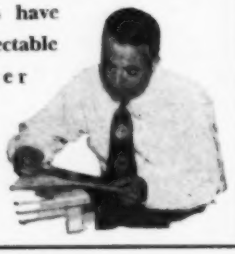
but common-sense carefulness will reduce the number of cases. This includes good nutrition and proper relaxation, which build up the body's resistance, and the avoidance of places where colds are rife. Of course, we may not wish to get rid of our colds. Many a business man has found that a slight illness—"oh, nothing serious, you know; just a cold in the head"—is a far lesser evil than a conference for which he is not prepared. This is not to suggest that colds are "faked." Dr. Flanders Dunbar, writing about psychosomatic medicine, says the surprising thing is that so many, faced with an unpleasant situation, actually do come down with real sniffles and genuine sneezes. On the other hand, she writes: "A great many of them have been 'spoiled brats' who find in the sick bed the only substitute available at their age for the pampering which they enjoyed as children. They have never untied themselves from mother's apron strings."

—From the January *Monthly Letter*, published by the Royal Bank of Canada, Montreal.

The HIGH PRECISION STANDARDS of ZENITH RADIO call for EQUALLY HIGH VISUAL STANDARDS

Writes Dr. Carl Maggio: "With our Keystone OVS service we have conducted over 20,000 employee screening tests since 1946, with excellent results in all four requisites of our visual program: (1) Establishment of visual standards for each occupation. (2) Screening new applicants and classifying according to visual skills. (3) Visual classification of employees for transfer and promotion. (4) Recommendation for eye examination where needed.

"There is little reason for condoning visual defects in industry—at least 90% have proven correctable with proper care."



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2500 Industrial Companies Use KEYSTONE Occupational Visual Tests

Goals

A GOOD review of the cooperation desired between labor and management is seen in Public Affairs Pamphlet No. 151 by Osgood Nichols and T. R. Carskadon, "Can Labor and Management Work Together?" published in 1949. Reference points of interest to industry might be found in the following material: The fundamental goals of a worker are (1) *Security*, which is defined as the right to work continuously at a reasonably good wage. (2) *A chance to advance*, which is described as just the good old American chance to get on in the world and to go from one job to the next higher job. (3) *Being treated like a human being*, this involves a recognition by management that workers have daily lives, personal problems, temptations, ambitions, loves and hates. (4) *A desire for simple, genuine human dignity*, which can be interpreted as the desire by the worker to feel he is personally performing creditably in a job which contributes something to the aggregate of human happiness and advancement. The four goals of management were listed as: (1) The economic welfare of the company. (2) Relations with its own employees. (3) Freedom to manage. (4) Business-like responsible relations.

Medical Research

AMONG the medical research accomplishments at the National Institute of Health, research bureau of the U.S. Public Health Service, was the discovery of means to conduct basic research on eclampsia, a disease of pregnancy which baffled the medical profession for centuries. Scientists at the Institute also developed a method for large-scale inexpensive pro-

duction of amino acids, used in the intravenous feeding of patients with cancer of the stomach and other obstructions of the gastro-intestinal tract. Basic studies of a wide variety of infections, such as poliomyelitis, rabies, Q fever and brucellosis have contributed to the development of more effective methods for the prevention, diagnosis and treatment of communicable diseases. A new lead was discovered toward understanding how blood is formed, and another toward the development of protection against peptic ulcer. Excellent promise also was obtained for improvements in present means of preventing and treating whooping cough. Research activities were strengthened in the fields of cancer, heart disease, tropical diseases, physical biology and biologics control.

—Department News Release, February 23, 1950.

Wisconsin Clinics

DANIEL E. DORCHESTER, M.D., of Sturgeon Bay, is Chairman of the Committee on Industrial Health of the State Medical Society of Wisconsin. His Committee, in cooperation with the State Industrial Hygiene Unit, and the Milwaukee, Sheboygan and Wood County Medical Societies, is sponsoring three Plant Clinics as follows: (1) *April 13*—afternoon plant tour, Kohler Mfg. Co. plant, Kohler Village, followed by a Scientific Program at which ERNEST MILLER, M.D., Milwaukee, will talk on "The Treatment of Electric Burns," WILLIAM FRACKELTON, M.D., Milwaukee, on "The Treatment of Hand Injuries," and CLIFFORD KALB, M.D., Milwaukee, on "Industrial Dermatoses." At the Dinner, A. J. MATHIAS will speak on "Industrial Safety," and CHESTER KURTZ, M.D., on "Managing the Cardiac in Industry." (2) *April 20*—afternoon plant tour, Consolidated Water Power & Paper Co., Wisconsin Rapids, followed by a Scientific Program at which the above-named speakers will present the subjects listed. (3) *May 3*—afternoon plant tour, Globe-Union, Milwaukee, after which, at the Scientific Program at Hotel Plankinton, HARVEY S. ALLEN, M.D., Chicago, will speak on "The Treatment of Hand Injuries," and ELSTON BELKNAP, M.D., Milwaukee, on "Toxic Solvents." At the Dinner to follow, B. A. KRAWCZYK, Director, Compensation Department, Allis Chalmers Mfg. Co., Milwaukee, will talk on "Industry Looks at the Doctor," and LEROY H. SLOAN, M.D., Chicago, on "Industrial Aspects of Heart Disease." Further information may be obtained by addressing DR. DANIEL DORCHESTER, at 704 East Gorham St., Madison 3, Wisconsin. Reservations are also being handled by DR. DORCHESTER.

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*Derzavis, J. L.; Rice, J. S., and Leland, L. S.: Topical Bacitracin Therapy of Pyogenic Dermatoses; a Clinical Report, J.A.M.A. *141*:191 (Sept. 17) 1949.

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Why Nutrition?

WITHIN the past generation, the science of nutrition has made sound and stable advances —greater progress than in all the preceding centuries. Discovery of the vitamins and their manifold relation to the health of the body came from biochemists working on problems of nutrition. The action of nutrients in the bloodstream and on the body tissues has been explored and much information gained bearing on human health. New knowledge has been acquired relative to the re-

quirements of man for many of the nutrients—vitamins and amino acids. Diseases such as diabetes and liver injury have been controlled and prevented through utilization of nutrition. High blood pressure and hardening of the arteries, the greatest killers of present-day Americans, are diseases in which nutrition is somehow intimately concerned. Guarding the life of the mother and child, nutrition has played an important part in prenatal care. It has been utilized in preoperative and postsurgical care. It has been recognized as the prime factor in developing the health of children and in maintaining the health of the aged. Yet, much remains to be done in nutrition, in *research* for new knowledge, in *teaching* leaders who can carry forth the present knowledge of this science, and in *service* through communities, hospitals, and industries.... The promise of a longer and happier "prime of life" for millions of Americans is the promise from better nutrition. Today in America where we have control and prevention over those diseases caused by improper sanitation, such as typhoid fever, and where we have such wonder drugs as penicillin and aureomycin to combat the ordinary infectious diseases such as pneumonia, nutrition stands as the single most important factor affecting our personal well-being and that of our families, neighbors, and friends.

—From "Why the Science of Nutrition?" by FREDRICK J. STARE, M.D., Harvard School of Public Health, in *Nutrition Reviews*, January, 1950.

ŌNOX
is used by
71% of the largest
industrial plants in the U. S. A.

Horse sense about ATHLETE'S FOOT

91 skin specialists condemn old-fashioned foot baths as being "illogical and potentially harmful to the skin."
(Archives of Dermatology and Syphilology for April, 1942.)
The best way to prevent Athlete's Foot, say these specialists, is to *stop* trying to disinfect the feet. Concentrate instead on improving the condition of the skin.

✓ *A sound skin is nature's best protection against fungus attack*

That is good horse sense. And it's the basic principle of the Onox skin-toughening method of Athlete's Foot prevention. Instead of disinfecting the feet, Onox mineral salts toughen the shoe-softened skin *and restore its natural resistance to fungus growth.* No fungus growth—no Athlete's Foot.

The above statements are substantiated in tests made by Pease Laboratories, Inc. of New York, and the Department of Bacteriology of a large University. A summary of these tests is available on request.

60-DAY TRIAL OFFER *Try Onox at our risk for 60 days. At the end of that time you must be completely satisfied or you owe us nothing. For full details, write*

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WAREHOUSES: BROOKLYN, N.Y. · CLEVELAND · NEW ORLEANS · LOS ANGELES
Originators of the skin-toughening method of Athlete's Foot Prevention

Canada Survey

A MOST important part of the industrial relations program of the 1950 plant is that area which includes medical safety and fire procedures. In order to ascertain how Canadian production management is facing this problem a cross-section of plant executives has been interviewed. The survey questionnaire is designed to find out what type of organization is in operation and how effective it is: *Do Job Applicants have a Medical Examination Before Hiring?* Approximately one-third of the plants contacted report that they require a medical examination of all prospective employees. This practice does not seem to be true of any particular industry. Some industries where this has been found valuable include: aircraft, tea and coffee, trucks and buses, textiles, glassware, containers, asphalt and tile, and machinery manufacturers. While some firms may reject as many as 50% of their applicants on the basis of the medical examination, the average percentage of rejections is from 1% to 2%.

About one-third of the firms having medical check-ups mention that they have a general examination. The remaining two-thirds find that a more detailed examination is to be preferred. *Have You a Plant Doctor?* Four out of 10 Canadian plants have a plant doctor. The plant doctor has charge of medical examinations and is available to handle emergency cases in the event of accidents. In every case he is found to be a part-time employee who still carries on with his normal medical practice. This would seem to be the best arrangement for all concerned. *Have You Plant Nurses?* The same number of firms which have doctors, report having plant nurses. All of the nurses, however, are retained on a full-time basis. Most firms have only one nurse. Some larger companies report that they have as many as three nurses on the staff. Where a company is working several shifts there may be a nurse for each shift.... *Have You a Medical Dispensary?* Two-thirds of the companies where interviews were carried out have a medical dispensary. Commonly only one person is to be found on the dispensary staff. In larger companies or in firms where a 24-hour shift is in operation as many as four may be on the dispensary staff.

—*Toronto Canada, Manufacturing & Industrial Engineering,* January, 1950.

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Easy ON THE SURGEON:
Superior cutting efficiency, predicated upon inimitable, uniform sharpness throughout the entire cutting edge, Rib-reinforcement—an exclusive feature that provides added strength and a degree of rigidity best calculated to resist lateral pressure, insures dependable blade performance which serves the surgeon to the greatest advantage.
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Precision fabricating methods and rigid inspection controls insure blade-for-blade uniformity with a resultant capacity to accurately and firmly fit every B-P Handle designed for component use. Various blade patterns can be interchanged instantly as required.
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The buyer is assured of 12 perfect blades in every dozen RIB-BACKS purchased. Their superior qualities and longer periods of satisfactory utilization are also factors that reduce blade consumption to an economic minimum.
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Ask your dealer
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B-P
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The Cold War

THE NAVY hopes to settle the controversy over the effectiveness of antihistaminics in the prevention and treatment of common colds. Two 500-men groups of Navy enlisted personnel at the Great Lakes Training Center have started five-month tests on two separate aspects of investigation. One is on prevention, the other on the treatment phase. The investigation apparently was prompted because some scientists don't think this cold "cure" is so hot.

—*Chem. & Eng. News,* January 2, 1950.

A Good Doctor

WHAT does it take to make a *good* doctor? Perhaps a little more: Faith—in oneself, in one's ability to do the job well despite the minor defeats and frustrations which are inevitable; Hope—in the future of medicine, and a desire personally to contribute some part to the widening of the scope of that future; Charity—a real love of people, all kinds of people in all walks of life, a personal interest in their welfare, and a willingness and eagerness to accept some responsibility in that welfare.

—From "Women in Medicine," by MILDRED STAHLMAN, in *Trident* (Delta Delta Delta), January, 1950.

Preventive

TO PROMOTE the health of employees, a number of business and industrial establishments are providing free tablets of a cold preventive in workrooms. The employees are instructed how to use the tablets, and a dosage is administered at the first hint of a cold. Employers believe prompt treatment may cut down the half-billion colds which impair the health of their workers every year.

—*Summit, New Jersey, Herald,* February 23, 1950.

O_3, That's It

THERE is a new theory on the nature of the smog contamination in the Los Angeles area. Analysis of air samples for ozone reveals that this material is present in many times its normal constituency. With the warning, old hands at high energy discharges even claim they can recognize the odor. Nobody knows yet where the stuff is coming from, but one early theory has already been nullified. Although the ozone content of the upper atmosphere is known to be higher than at sea level, compression of that air to sea level densities could not mathematically account for an ozone content as high as reported. It is possible that the analysis procedures aren't specific.

—From *Chem. & Engr. News*, February 20, 1950.

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We cordially invite you to get further information and samples of Tubegauz at the two conventions.

American Association of Railway Surgeons — Drake Hotel, April 4-6..... **BOOTH 16**

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***Tubegauz* Metal Service Tray**

at no cost

Heavy grade sheet metal, triple coated white baked enamel. Tray is 8¾ inches wide — 8 inches deep. Back is 5 inches high. Substantial — handy — neat — attractive. Will not scratch, crack, peel.

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Special slots on back for hanging on wall. Screws furnished.

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Nutritional Truths

IF PEOPLE were well fed there would be far less need of hospitals. The number of hospitals in a country constitutes a rough index of the nutritional state of its citizens. Increasing the number of hospitals is the wrong way to deal with primary deficiencies; yet that is the inept way we pattern our policies. But there is another angle to the nutrition problem that is of paramount importance. Communism holds no interest for peoples who are well fed. Those parts of the world which manifest unrest are centers of poor nutrition. Lord John Boyd Orr, the British food authority, puts the matter in a nutshell: "What is called communism in backward countries is hunger becoming articulate.... You can't build world peace on empty stomachs." Feed people properly and physical health and social contentment will prevail. Under such a planned policy trade would jump and new wealth be created. We who are so dedicated to free enterprise and the profit system should be crusaders for good nutrition. Doctors, of all people, understanding thoroughly the fundamentals involved, should be in the forefront as teachers and preachers of this gospel, and shapers of action. It's definitely their province.

—Editorial in *Medical Times*, March, 1950.

New Safety Directory

BEST'S Safety Directory for 1950-1951, covering safety, fire protection and control, hygiene, first-aid and sanitation, is now available. The Directory combines the practical features of a safety manual, directory, index, encyclopedia and catalog into a single illustrated, 511-page volume. It is priced at $5.00, with lower rates for quantities, and may be obtained from the home office of the Alfred M. Best Company, 75 Fulton Street, New York 7, New York.

No. 1 Hic Town

DRINKING is becoming the number one problem of the national capital. The city's press and radio have launched a drive to curb alcoholism. The capital soaks up three times as much liquor as the national per capita average. Even making allowances for tourists, Washington drinking is far ahead of the rest of the nation.

Plant managers report:

formula SBS-50 . . new cleaner-sanitizer saves up to 50% of cleaning labor CHEMICAL ACTION DOES THE WORK

The new SBS-50 Cleaner-Sanitizer, recently developed in the laboratories of The Sugar Beet Products Co., eliminates the guess work and labor of mixing expensive disinfectants with detergents at your plant. SBS-50 SANITIZES AS IT CLEANS! No rinsing is necessary . . . no rubbing or scrubbing is required. SBS-50 is the answer to your cleaning-sanitizing problems for toilets, sinks, showers, wash room floors, cafeterias, etc. It is guaranteed to reduce bacterial counts of casual contaminants to safe levels as judged by public health requirements. Convince yourself of this 50% saving in cleaning labor by writing for a free sample of the new Formula SBS-50 Cleaner-Sanitizer.

FORMULA SBS-11 Heavy Duty Skin Cleanser is used today in more than 10,000 industrial plants. Even most stubborn grime and grease disappear quickly, safely under the soil-penetrating action of the new SBS-11. Contains no added alkalis, no harmful mineral abrasives. It protects your skin's "acid mantle," nature's own bacteria barrier. In 5-lb. boxes per case.

TYPE R DISPENSER . . . the finest dispenser for real washroom efficiency. Heavy gauge steel shell and mounting bracket chromium plated with a high luster durable finish. Economical "circle" dispensing, adjustable to five different amounts of soap. Drip shield prevents clogging caused by splashing. All working parts easily removable, permitting complete servicing without removal from mounting. Quantity discounts available.

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TENSOR*
ELASTIC BANDAGE

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Live Rubber Thread

THAT'S WHY TENSOR stretches to more than twice its own length—and provides such easy unconstricted support.

You can use TENSOR for *any* elastic bandage use because it has these advantages:

- exerts uniform controlled pressure without constriction.
- has *constant elasticity* that rubberless bandages can't match.
- *stays put*—no need for frequent readjustments; is comfortable to wear.
- *is inconspicuous*—women like its neutral color and smooth selvedge edge.
- withstands repeated laundering.

You can depend on TENSOR for *any* elastic bandage use.

ORDER THROUGH YOUR DEALER

TENSOR is available in 2, 2½, 3, 4 and 6-inch widths by 5½ yards stretched.

DOCTORS *recommend* **TENSOR** *for many uses:*

THERE IS NO BETTER ELASTIC BANDAGE THAN TENSOR!

BAUER & BLACK *FIRST IN ELASTIC SUPPORTS*

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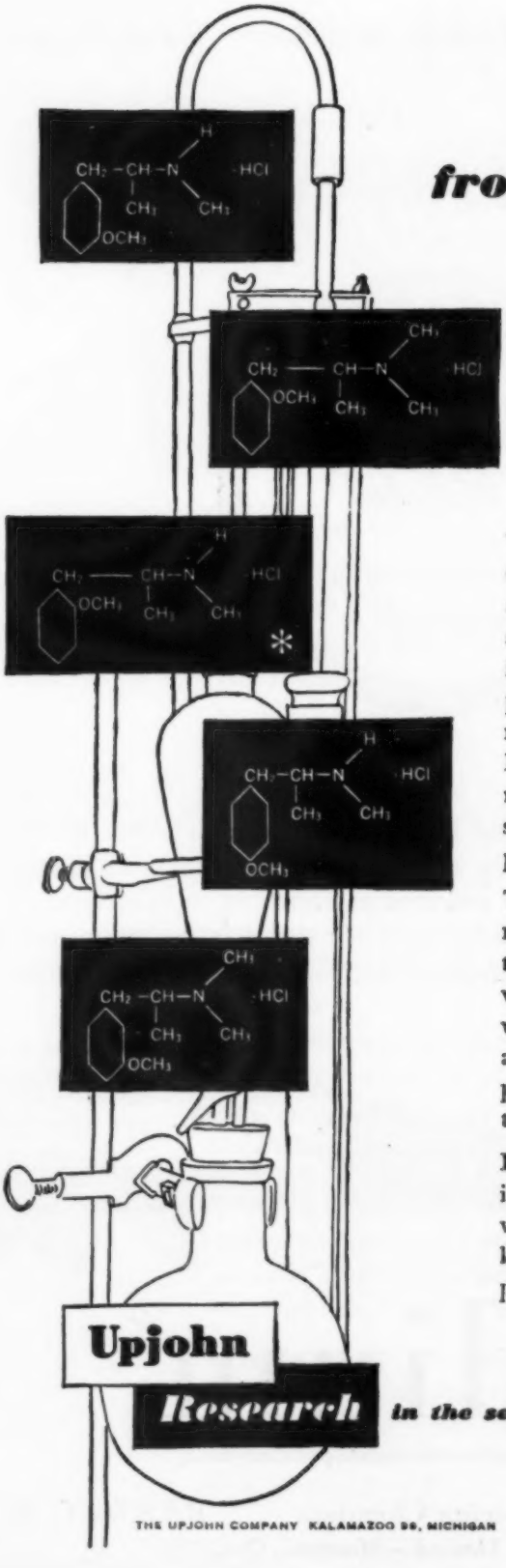

from this series of isopropyl amines . . .

The remarkably selective new bronchodilator, Orthoxine* Hydrochloride, was discovered among this series of isopropyl amines synthesized and studied by Upjohn research workers in their search for more effective antiasthmatic preparations. The *in vitro* and *in vivo* experiments showed that the starred compound, Beta - (orthomethoxyphenyl) - isopropylmethylamine hydrochloride, possessed actions specifically indicated in treatment and prophylaxis of bronchial asthma.

The major activity of Orthoxine Hydrochloride administered by mouth is bronchodilation. Orthoxine in usual doses exerts minimal vasopressor, cardiac and CNS side effects noted with the use of sympathomimetic "pressor" amines. Wide clinical experience has repeatedly confirmed its specific therapeutic advantages.

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Research ***in the service of the profession of medicine***

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meantime enjoys

Gratifying Relief

from distressing symptoms

With orally administered Pyridium—an effective, *safe* urinary analgesic—physicians can give patients with urinary tract infection prompt relief from such symptoms as urinary frequency and pain and burning on urination.

Pyridium in therapeutic dosage is virtually nontoxic and may be administered throughout the course of treatment with streptomycin, penicillin, the sulfonamides, or other specific therapy.

Pyridium is the trade-mark of Nepera Chemical Co., Inc., successor to Pyridium Corporation, for its brand of phenylazo-diamino-pyridine HCl. Merck & Co., Inc. sole distributor in the United States.

The complete story of Pyridium and its clinical uses is available upon request.

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The concept that allergic tissue responses are important contributory factors in upper respiratory infections has been widely accepted. To combat these allergic manifestations more effectively, the time-tested, dependable decongestant—Neo-Synephrine hydrochloride— has been combined with a new, highly active antihistaminic—Thenfadil hydrochloride.

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HIGHLY EFFECTIVE DECONGESTANT ANTIHISTAMINIC

For symptomatic control of the common cold, allergic rhinitis including hay fever, vasomotor rhinitis and sinusitis.

Well Tolerated—No Drowsiness—Neo-Synephrine Thenfadil nasal solution in clinical tests was well tolerated except for a transitory stinging in a few cases. There was essential freedom from central nervous system stimulation: trepidation, restlessness, insomnia; neither was there drowsiness.

Effective—In common colds, allergic rhinitis including hay fever, vasomotor rhinitis, and sinusitis, excellent results were reported in nearly all cases. There was prompt, prolonged decongestion without compensatory vasodilatation. Repeated doses did not reduce the consistent effectiveness.

Dose: 2 or 3 drops up to ½ dropperful three or four times daily. Neo-Synephrine Thenfadil solution contains 0.25 per cent Neo-Synephrine hydrochloride and 0.1 per cent Thenfadil hydrochloride (N, N-dimethyl-N'-(3-thenyl)-N'-(2-pyridyl) ethylenediamine hydrochloride) in an isotonic buffered aqueous vehicle. Supplied in bottles of 30 cc. (1 fl. oz.) with dropper.

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Comparative studies at various dosage levels show:

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Spring is the season when allergic rhinitis due to grass and tree pollens occurs, often simulating or aggravating the common "cold." For relief of catarrhal symptoms due to allergy, more and more physicians rely on

NEOHETRAMINE®

Hydrochloride

as their first choice in antihistaminic therapy, because it is effective and exceptionally well-tolerated.

INDICATED in allergic rhinitis and allergic dermatoses.

*Schwartz, E.: Ann. Allergy 7:770 (Nov.-Dec.) 1949

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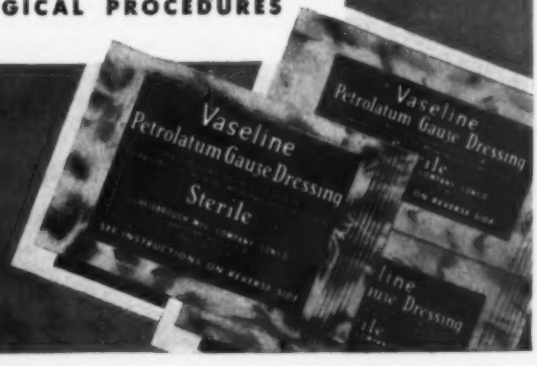

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Extensive studies* by the Bureau of Human Nutrition have established that breakfasts rich in protein and supplying 500 to 700 calories, effectively promote a sense of well-being, ward off fatigue, and sustain blood sugar levels at normal values for the entire morning postbreakfast period.

These physiologic advantages are related mainly to the protein content rather than to the caloric content of the breakfast. In fact, when isocaloric breakfasts were compared, those with the higher amounts of protein led to the greatest beneficial effects. Breakfasts providing the lower quantities of protein (7 Gm., 9 Gm., 16 Gm., and 17 Gm. respectively) produced a rapid rise in the blood sugar level and a return to normal during the next three hours. Breakfasts providing more protein (22 Gm. and 25 Gm. respectively) produced a maximal blood sugar rise which was lower than that following the breakfasts of lower protein content, but the return to normal was delayed beyond the three hour period.

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*Orent-Keiles, E., and Hallman, L. F.: The Breakfast Meal in Relation to Blood-Sugar Values, Circular No. 827, United States Department of Agriculture, Bureau of Human Nutrition and Home Economics, Agricultural Research Administration, Dec., 1949.

The Seal of Acceptance denotes that the nutritional statements made in this advertisement are acceptable to the Council on Foods and Nutrition of the American Medical Association.

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We invite you to try Chloresium Ointment or Chloresium Solution (Plain) on your most resistant case—some ulcerative lesion, chronic osteomyelitis, wound, burn, dermatitis, or any other condition which calls for accelerated healing. Just mail the coupon below.

*Complete bibliography and reprints available on request.

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Please send clinical samples of Chloresium Ointment and Solution (Plain). I also want literature ☐; samples of Nasal and Aerosol Solutions ☐ (check if desired).

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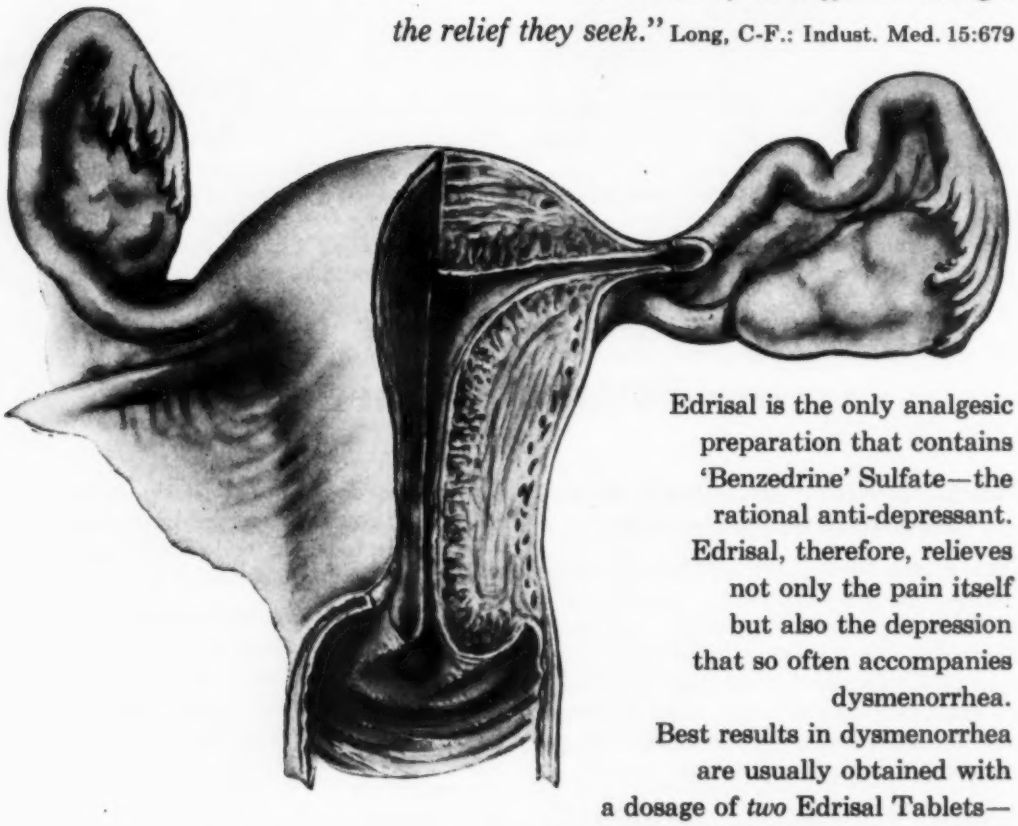
~~dysmenorrhea~~

"We use [EDRISAL] *with the knowledge that 9 out of 10 sufferers will get the relief they seek."* Long, C-F.: Indust. Med. 15:679



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Each Edrisal* tablet contains Benzedrine* Sulfate (racemic amphetamine sulfate, S.K.F.), 2.5 mg.; acetylsalicylic acid, 2.5 gr.; and phenacetin, 2.5 gr. *Available on prescription only.*

its dual action relieves pain, lifts mood

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WILL YOU MAKE

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SEE AT ONCE PHILIP MORRIS ARE LESS IRRITATING.

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**Proc. Soc. Exp. Biol. and Med., 1934, 32, 241-245; N. Y. State Journ. Med., Vol. 35, 6-1-35, No. 11, 590-592; Laryngoscope, Feb. 1935, Vol. XLV, No. 2, 149-154; Laryngoscope, Jan. 1937, Vol. XLVII, No. 1, 1. 58-60*

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PROMPT PATIENT RELIEF

Local application provides prompt and continued control of pain.

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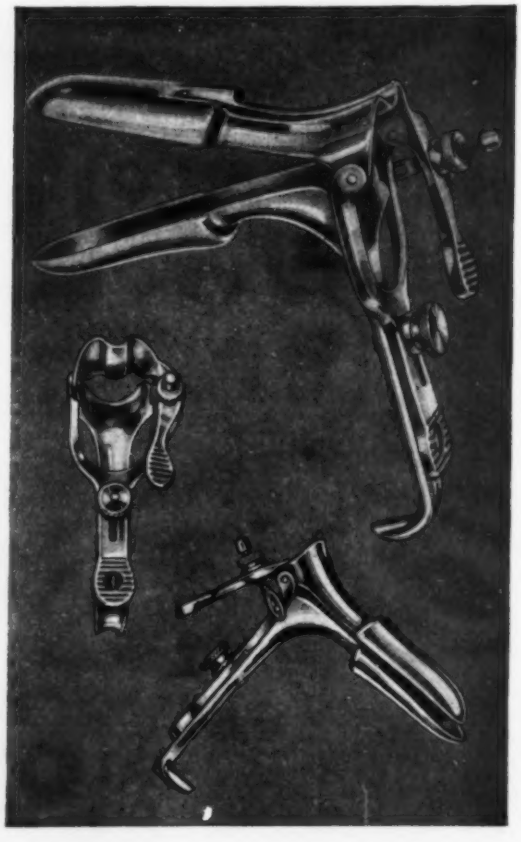

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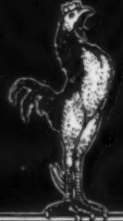

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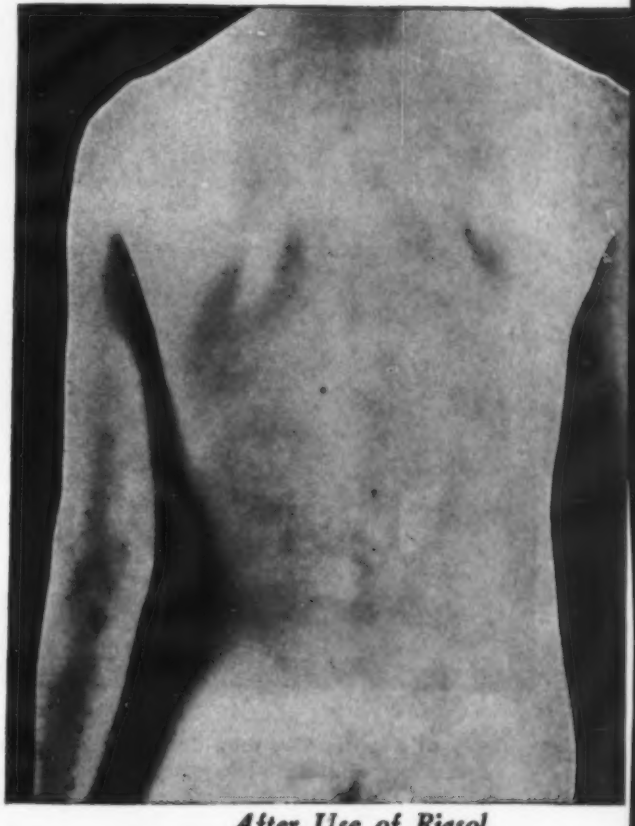

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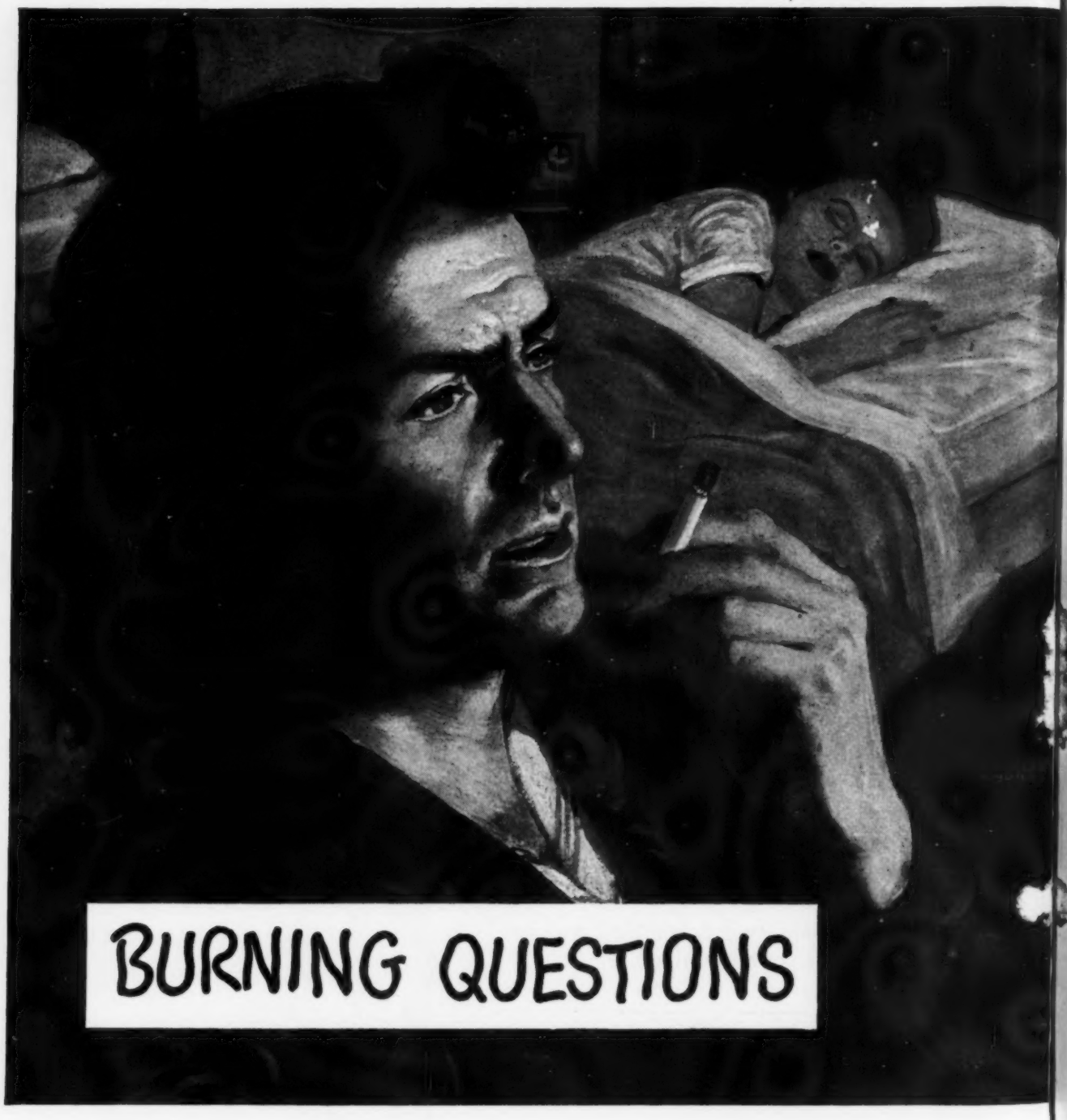

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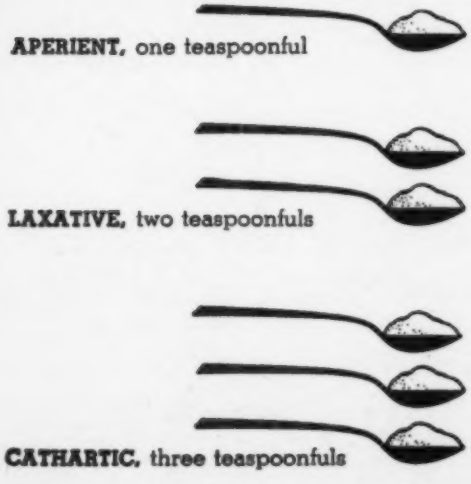

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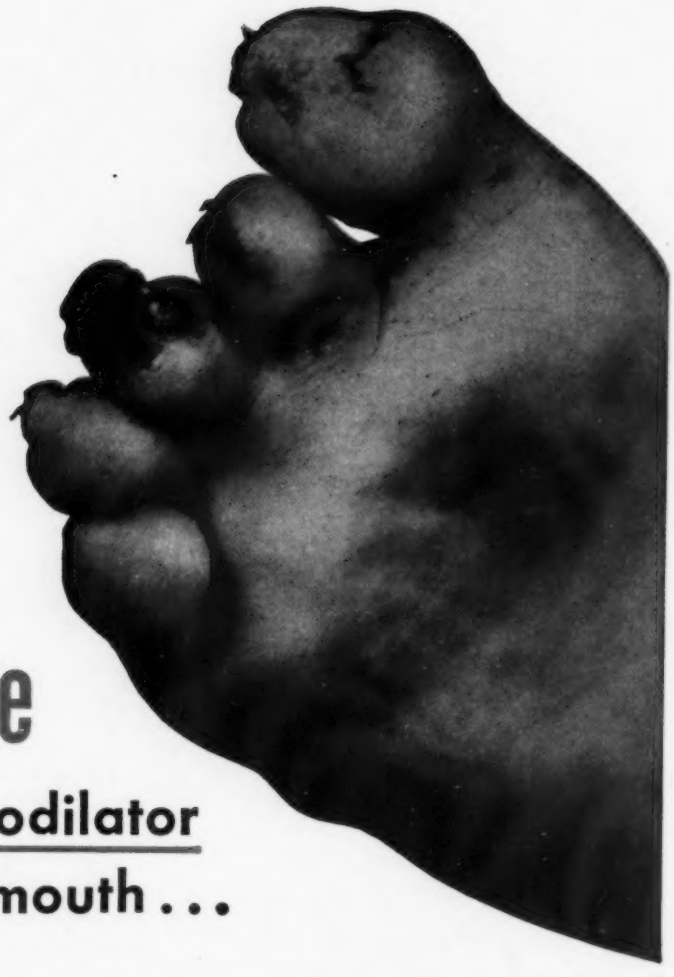

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1. Rogers, Max P.: J.A.M.A., May 21, 1949
2. Wyatt, Bernard L.: Ann. West. Med. & Surg., Aug. 1949
3. Grimson, Marzoni, Reardon & Hendrix: Ann. Surg., 127:5, May 1948

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